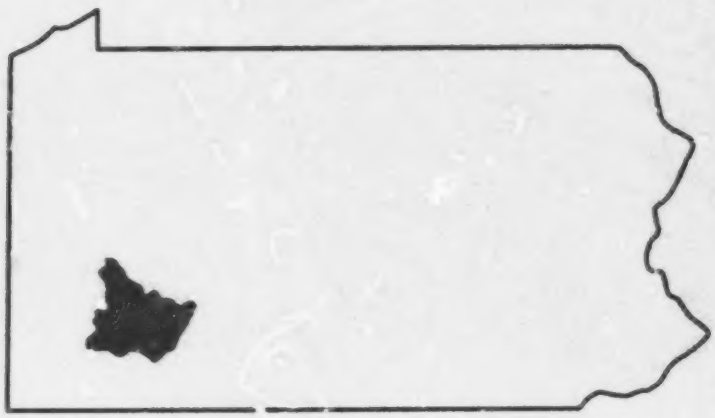
FED ... 1987
594-C-38
COMPLETED 119
FEM 1.209: 420878

FLOOD INSURANCE STUDY

ORIGINAL



TOWNSHIP OF HEMPFIELD, PENNSYLVANIA
WESTMORELAND COUNTY

APRIL 3, 1987

Federal Emergency Management Agency

COMMUNITY NUMBER - 420878

BEST COPY AVAILABLE

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

BEST COPY AVAILABLE

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgements	1
	1.3 Coordination	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	6
	2.3 Principal Flood Problems	7
	2.4 Flood Protection Measures	7
3.0	ENGINEERING METHODS	10
	3.1 Hydrologic Analyses	10
	3.2 Hydraulic Analyses	13
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	15
	4.1 Flood Boundaries	15
	4.2 Floodways	15
5.0	INSURANCE APPLICATION	16
	5.1 Reach Determinations	21
	5.2 Flood Hazard Factors	22
	5.3 Flood Insurance Zones	22
	5.4 Flood Insurance Rate Map Description	27

BEST COPY AVAILABLE

TABLE OF CONTENTS - continued

	Page
6.0 OTHER STUDIES	27
7.0 LOCATION OF DATA	28
8.0 BIBLIOGRAPHY AND REFERENCES	28

FIGURES

Figure 1 - Vicinity Map	3
Figure 2 - Flood Photograph During March 1936 Flood Near Confluence of Sewickley Creek and Jack's Run	8
Figure 3 - Flood Photograph During Normal Flow Near Confluence of Sewickley Creek and Jack's Run	8
Figure 4 - Jack's Run Adjacent to the Greater Greensburg Sewage Treatment Plant, Looking Downstream	9
Figure 5 - Jack's Run Adjacent to the Greater Greensburg Sewage Treatment Plant, Looking Upstream	9
Figure 6 - Floodway Schematic	21

TABLES

Table 1 - Summary of Discharges	11 - 13
Table 2 - Floodway Data	17 - 20
Table 3 - Flood Insurance Zone Data	23 - 26

EXHIBITS

Exhibit 1 - Flood Profiles	
Tributary No. 1	Panel 01P
Tributary No. 3	Panels 02P - 06P
Brush Creek	Panels 07P - 11P

BEST COPY AVAILABLE

EXHIBITS - continued

Exhibit 1 - Flood Profiles - continued		
	Tributary No. 4	Panels 12P - 13P
	Little Crabtree Creek	Panels 14P - 15P
	Crabtree Creek	Panel 16P
	Little Sewickley Creek	Panel 17P
	Sewickley Creek	Panels 18P - 20P
	Jack's Run	Panels 21P - 23P
	Slate Creek	Panels 24P - 27P
	Tributary No. 2	Panel 28P
	Zeller's Run	Panels 29P - 30P
	Tributary No. 5	Panel 31P
	Township Line Run	Panels 32P - 35P
	Belson run	Panel 36P - 37P
Exhibit 2 - Flood Boundary and Floodway Map Index		
	Flood Boundary and Floodway Map	

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

BEST COPY AVAILABLE

FLOOD INSURANCE STUDY
TOWNSHIP OF HEMPFIELD, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Hempfield, Westmoreland County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses in this study represent a revision of the original analyses by Michael Baker, Jr., Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. H-3812. The work for the original study was completed in May 1977. The updated version was prepared by the Pittsburgh District of the U. S. Army Corps of Engineers (COE) during the preparation of a Flood Plain Information Report for Upper Sewickley Creek Basin. The work for this updated study was completed in October 1980.

1.3 Coordination

The identification of streams for detailed and approximate study were selected and agreed upon by representatives of the Township of Hempfield, FEMA, and Michael Baker, Jr., Inc. (the study contractor) at the initial Consultation and Coordination Officer's (CCO) meeting on September 17, 1975. Another meeting was held on October 1, 1975, between township

BEST COPY AVAILABLE

officials and representatives of the study contractor to further clarify and explain the purpose and scope of this study.

The following agencies were contacted for coordination of mapping and hydrologic and hydraulic information during the course of this study: the Pittsburgh District of the COE, the Pennsylvania Department of Community Affairs, the Pittsburgh Regional Office, the Westmoreland County Planning Commission, the Westmoreland County Conservation District, and the Pennsylvania Department of Transportation.

The township provided historical information and a street map to aid in the preparation of this study. Township official were informed of progress throughout the course of the study.

The final CCO meeting was held on August 16, 1977, to review the results of the study. This meeting was attended by representatives of the township, FEMA, the study contractor, and interested citizens.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Hempfield, Westmoreland County, Pennsylvania. Not included in this study are the Boroughs of Youngwood, New Stanton, Hunker, Arona, Adamsburg, Southwest Greensburg, and South Greensburg, and the City of Greensburg, which are located within the corporate boundaries of Hempfield. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods in the original study:

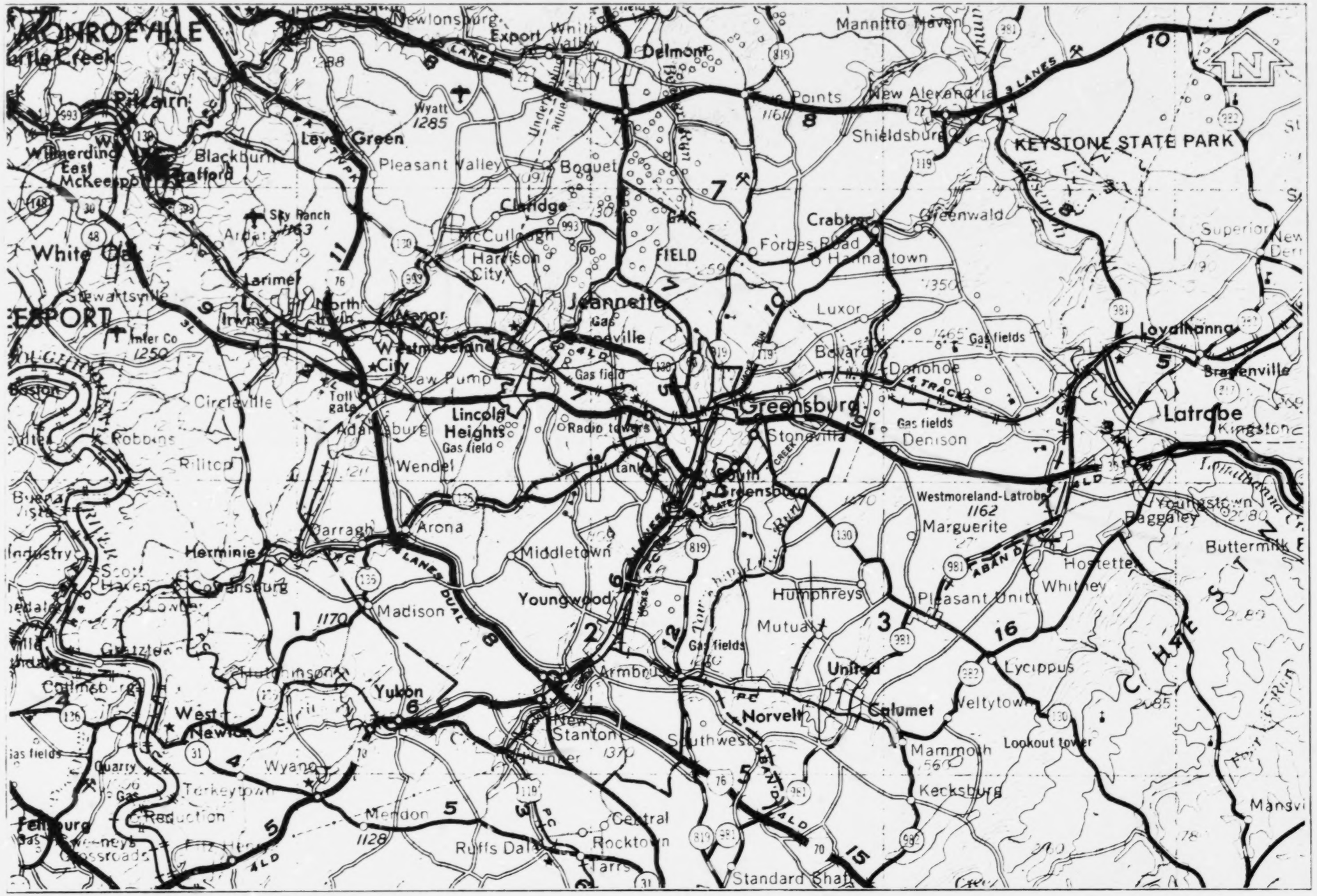
Tributary No. 1, from its mouth to a point approximately 0.83 mile upstream.

Tributary No. 3, from its mouth to a point approximately 1.60 miles upstream.

Brush Creek, from the Township of Hempfield corporate limits to a point at its confluence with Tributary No. 3 at mile 0.81 and from a point approximately 0.06 mile upstream from the State Route 766 bridge over Brush Creek to a point approximately 0.66 mile upstream from the bridge for a total length of approximately 1.41 miles.

Tributary No. 4, from its mouth to a point approximately 0.57 mile upstream.

BEST COPY AVAILABLE


MONROEVILLE
Turtle Creek
Pitcairn
Wilmerding
East McKeesport
McKeesport
Blackburn
Wyatt 1285
Layer Green
Pleasant Valley
Boquet
Claridge
Sky Ranch 1263
White Oak
Larimer
Stewartsville
ESPORT
Inter Co 1250
Irwin
North Irwin
Manor
Westmoreland City
Jeannette
Harrison City
McCullough
Harrison
Delmont
Export
Newlonsburg
Mannitto Haven
New Alexandria
Shieldsburg
KEYSTONE STATE PARK
Crabtree
Greenwald
Forbes Road
Hannastown
Superior
Luxor
Gas fields
Loyalhanna
Bradenville
Latrobe
Kingston
Beward
Donohoe
Greensburg
Stoneville
Denison
Gas field
Radio towers
Lincoln Heights
Gas field
Low Pump
Toll gate
Adamsburg
Circleville
Robbins
Ritztop
Wendel
Boston
Belle Vista
Industry
Scott
Haven
Herminie
Barragh
Arona
Middletown
Youngwood
Madison
Coalmont
Grapeville
Yukon
West Newton
Wyano
Quarry
Reduction
Fellsburg
Crossroads
Meadon 1128
Central Rocktown
Ruffs Dale
Harrs
Standard Shaft
New Stanton
Southwest
Norvelt
Armbrust
Humphreys
Mutual
Gas fields
United
Calumet
Westmoreland-Latrobe 1162
Marguerite
Pleasant Unity
Whitney
Hostetter
Baggaley
Youngstown
Buttermilk
Lycippus
Veltytown
Mammoth
Lookout tower
Kecksburg
Mansville
Export White Valley
Underground Pipeline
Turnpike
Penn Turnpike
Jeannette Gas field
Gas field
Gas fields
Denison
Gas fields
Gas fields
Gas fields

Little Crabtree Creek, from its mouth to a point approximately 0.77 mile upstream and from a point approximately 1.79 miles upstream from its mouth to a point at the confluence with Tributary No. 4, which is approximately 2.48 miles upstream from its mouth, for a total length of approximately 1.46 miles.

Crabtree Creek, from a point approximately 1.08 miles upstream from its confluence with Little Crabtree Creek at the corporate limits to a point approximately 1.93 miles upstream from Little Crabtree Creek for a length of approximately 0.85 mile.

Little Sewickley Creek, from the corporate limits upstream to a point approximately 0.82 mile upstream of the first intersection with the corporate limits.

The following streams were studied by detailed methods in the original study and were revised in this updated study:

Sewickley Creek, from a point approximately 0.15 mile upstream from the corporate limits to the Borough of New Stanton, approximately 3.48 mile upstream from the corporate limits, to a point approximately 6.22 miles upstream from the corporate limits for a total length of approximately 3.77 miles.

Jack's Run, from its mouth upstream through the Borough of Youngwood to a point approximately 4.28 miles upstream from its mouth; from a point at the Greensburg corporate limits approximately 6.47 miles from its mouth to a point at the second intersection of the Greensburg corporate limits approximately 6.67 miles upstream from its mouth; and from a point at the third intersection of the Greensburg corporate limits approximately 6.97 miles upstream from its mouth to a point at the confluence with Tributary No. 2, approximately 7.64 miles upstream from its mouth for a total length of approximately 5.15 miles.

Slate Creek, from its mouth upstream through the Borough of South Greensburg to a point at the Township of Hempfield corporate limits approximately 4.77 miles upstream from its mouth.

Tributary No. 2, from its mouth to a point approximately 0.20 mile upstream.

Zeller's Run, from a point at the first intersection with the Township of Hempfield corporate limits approximately 0.69 mile upstream from its mouth to a point at the second intersection with the corporate limits approximately 0.91 mile upstream from its mouth; from a point at the third intersection of the corporate

limits approximately 1.31 miles upstream from its mouth to a point at the fourth intersection of the corporate limits approximately 1.46 miles upstream from its mouth; and from a point at the fifth intersection of the corporate limits approximately 1.60 miles upstream from its mouth to the limit of detailed study approximately 1.70 miles upstream from its mouth for a total length of 0.47 mile.

Tributary No. 5, from a point at the first intersection of the corporate limits approximately 0.15 mile upstream from its mouth to a point at the second intersection of the corporate limits approximately 0.27 mile upstream from its mouth and from a point at the third intersection of the corporate limits approximately 0.50 mile upstream from its mouth to a point at the fourth intersection of the corporate limits approximately 1.0 miles upstream from its mouth for a total length of 0.70 mile.

This updated study also incorporated the detailed analyses for the following streams:

Township Line Run, from its confluence with Sewickley Creek to a point approximately 4.0 miles above its confluence.

Belson Run, for its entire stream length within the community.

The streams revised in this study were changed to incorporate a more up-to-date analyses.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

Flooding on smaller streams and on streams in underdeveloped portions of the township were studied by approximate methods. These included portions of Sewickley Creek, Jack's Run, Tributary No. 1, Tributary No. 2, Tributary No. 3, Brush Creek, Little Crabtree Creek, Crabtree Creek, Little Sewickley Creek, Down Run, Coal Tar Run, Township Line Run, Wilson Run, and various unnamed streams. Portions of Jack's Run, Zeller's Run, Coal Tar Run, Little Sewickley Creek, and various unnamed streams have watersheds of less than one square mile. These areas generate insufficient volumes of water to produce more than shallow flooding and, therefore, were studied by approximate methods in accordance with FEMA directives. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Township of Kempfield.

BEST COPY AVAILABLE

2.2 Community Description

The Township of Hempfield is located in the central portion of Westmoreland County in southwest Pennsylvania, approximately 25 miles east of Pittsburgh. The township is bordered by the City of Jeannette, the Borough of Manor, the Borough of Penn, the Township of Penn, and the Township of Salem to the north; the Township of Unity and the Township of Mount Pleasant to the east; the Township of East and the Township of South Huntingdon to the south; and the Borough of Madison, the Borough of Sewickley, and the Township of North Huntingdon to the west. The major streams in the township are Jack's Run, Sewickley Creek, Slate Creek, and Brush Creek. The predominant drainage pattern is in a southwestern direction, with four watersheds draining in that direction and two draining in a northern direction.

The study area encompasses 86.6 square miles with watershed elevations ranging from 920 feet to over 1,500 feet in the highest portion of the township.

The climate of the Township of Hempfield is the humid, continental type that is characterized by warm summers and cold winters. Annual precipitation normally ranges approximately 40 inches, of which nearly half falls between May and September. Temperatures range from lows of 0 degrees Fahrenheit (°F) to highs of 90°F, with an annual average of 50°F (Reference 1).

The Township of Hempfield is situated in the unglaciated Allegheny Plateau Physiographic Province. The Gilpin-Wharton-Cavode association and the Westmoreland-Guernsey-Clarksburg association are the dominant soil associations; these associations are characterized as deep and moderately deep, well-drained to somewhat poorly drained soils over acid, gray shale, siltstone, and interbedded sandstone. The slow infiltration capabilities of these soils are conducive to runoff (Reference 2). The watershed is characterized by somewhat steep, rounded hills with tree covered slopes that drain to grasslined valleys. A large number of small water basins typify the drainage patterns of the township.

The major source of employment in the township is manufacturing, mostly of primary metals and durables. Agriculture uses large amounts of land, specifically for dairy farms. Coal mining was formerly one of the most important occupations in the township.

The 1970 population of the Township of Hempfield was 39,196, an increase of 32 percent over the 1960 census (Reference 3). The township completely surrounds six boroughs and one city; the population for the area contiguous to Hempfield is approximately 70,000 persons. The accelerated pace of development within the township should continue since

BEST COPY AVAILABLE

there is a strong demand for housing and there is plenty of land and available sewage facilities in the area.

2.3 Principal Flood Problems

Sewickley Creek and Jack's Run are the principal flooding sources in the Township of Hempfield. Serious flooding has occurred on Sewickley Creek at Armbrust, the mouth of Jack's Run, and near Hunker. The flood plain at the confluence of Sewickley Creek and Jack's Run is particularly susceptible to flooding as shown in Figures 2 and 3. The 1954 and 1972 floods were the largest floods in the study area in the past 60 years. Other floods occurred in March 1936, June 1951, March 1963, and March 1964. No estimate for the recurrence interval of these events has been made.

2.4 Flood Protection Measures

Several local flood protection measures have been constructed on Jack's Run. Starting at Depot Street in the Borough of Youngwood and continuing approximately 1.04 miles upstream, Jack's Run has been straightened and a trapezoidal channel has been constructed with rip-rapped slopes. Approximately 0.3 mile of concrete trapezoidal channel has been constructed adjacent to the greater Greensburg Sewage Treatment Plant as shown in Figures 4 and 5. Two flood protection projects have been constructed on Jack's Run by the Commonwealth of Pennsylvania. Unit No. 1 starts at the confluence with Slate Creek and extends approximately 6,000 feet upstream. This consists mostly of an earthern trapezoidal channelization and approximately 500 feet of concrete channel starting downstream of Keystone Avenue and extending just upstream of State Route 119. Unit No. 2 starts at the upstream limit of Unit No. 1 and terminates at the CONRAIL culvert located approximately 1,100 feet north of Pittsburgh Street in Greensburg. This unit consists of an earthen trapezoidal channel and a concrete rectangular channel.

A flood protection project has been proposed by the Commonwealth of Pennsylvania for the tributary of Jack's Run near the Highland Avenue and Mount Pleasant Street area. At the present time, there are no funds allocated or anticipated for this project.

At the time of this report, no other flood protection projects affecting flooding within the Township of Hempfield exist or are proposed within the near future.

BEST COPY AVAILABLE

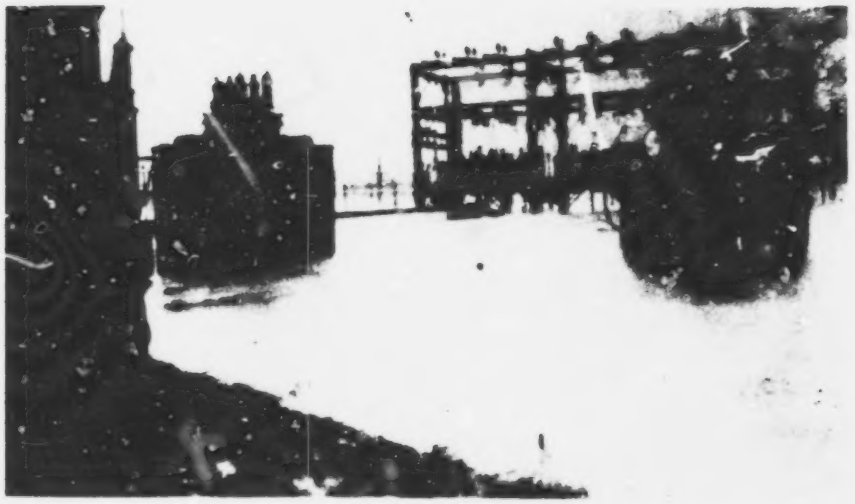


Figure 2. West Penn Power Company Substation near confluence of Sewickley Creek and Jack's Run during March 1936 flood.

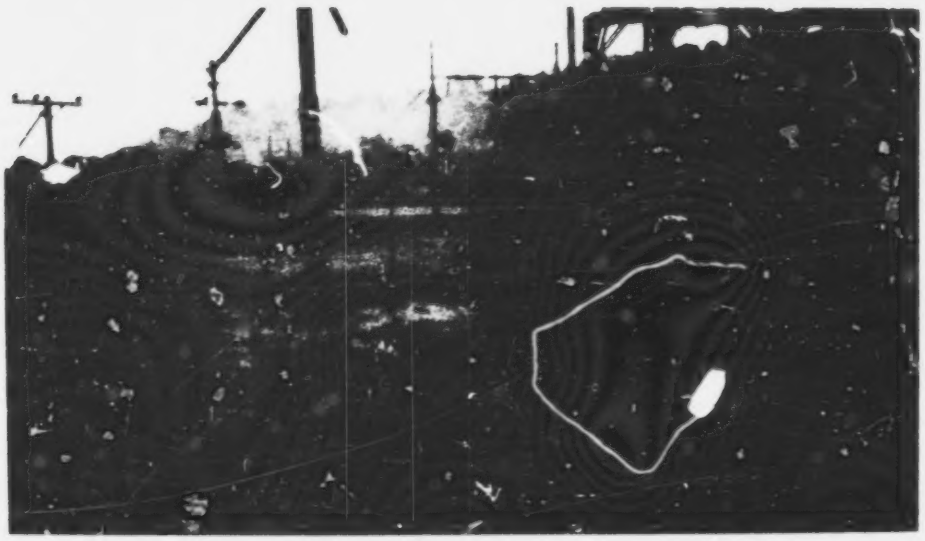


Figure 3. West Penn Power Company Substation near confluence of Sewickley Creek during period of normal flow.

Photos courtesy of COE

Figure 4 Looking downstream along Jack's Run at the 1,500 feet of concrete lined channel adjacent to greater Greensburg Sewage Treatment Plant.

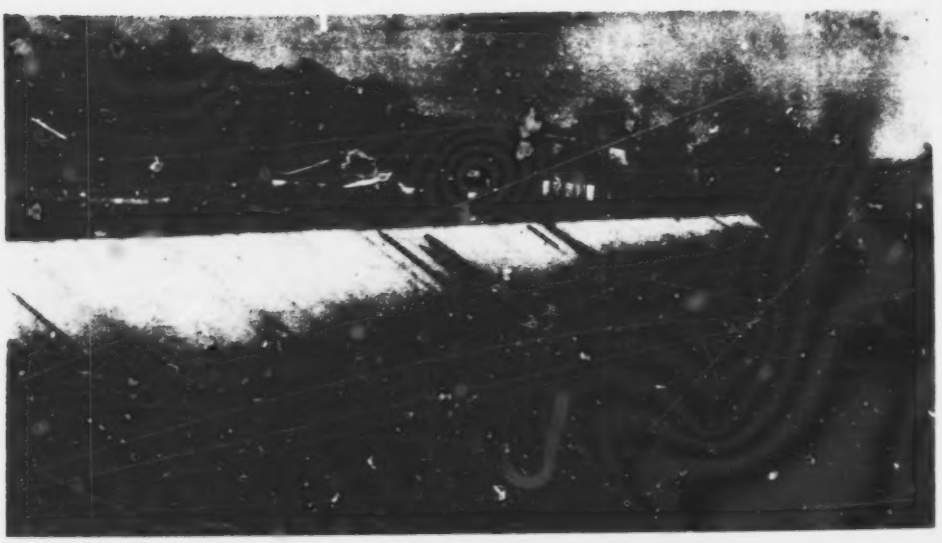


Figure 5. Looking upstream along Jack's Run toward channel improvement adjacent to greater Greensburg Sewage Treatment Plant.

Photos courtesy of COE

BEST COPY AVAILABLE

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The flows for Tributary No. 1 and Little Sewickley Creek were obtained from a regional analyses of similar gages assuming a log-Pearson Type III distribution (Reference 4).

Flows for Tributary No. 3 and Brush Creek were obtained from the publication Floods in Pennsylvania, Frequency and Magnitude (Reference 5).

The flows for Tributary No. 4, Little Crabtree Creek, and Crabtree Creek were determined using the PSU III, Flood Peak Frequency Design Manual (Reference 6).

In the upated study, the hydrologic analyses for the remaining streams were taken using the COE publication for Upper Sewickley Creek Basin (Reference 7). The computations for these flood plain analyses involved computation of stream flow hydrographs for selected storm events and the development of exceedence frequency curves at selected locations of interest. The methodology included application of synthetic storm precipitation data to a hydrologic watershed model that had been

BEST COPY AVAILABLE

calibrated from past flood data. The peak discharges were computed using the COE HEC-1 computer program (Reference 8).

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY NO. 1					
At the confluence with Jack's Run	2.3	640	970	1,110	1,490
TRIBUTARY NO. 3					
At the confluence with Brush Creek	3.0	540	810	970	1,320
At cross section G	2.3	440	660	790	1,080
At the Country Club Road bridge	1.4	290	430	510	700
BRUSH CREEK					
At the corporate limits	21.8	2,550	4,000	4,900	6,400
At the CONRAIL bridge at the corporate limits	9.5	1,328	2,055	2,411	3,295
At cross section J	5.5	870	1,340	1,620	2,180
TRIBUTARY NO. 4					
At the confluence with Little Crabtree Creek	1.1	270	390	445	580
At cross section C	0.4	135	190	215	280
LITTLE CRABTREE CREEK					
At the confluence with Crabtree Creek	7.1	900	1,450	1,700	2,200
At cross section C	6.5	830	1,400	1,600	2,100
At cross section F	3.6	620	910	1,050	1,350
At cross section J	3.3	580	860	980	1,280
At cross section K	3.1	550	810	930	1,200
CRABTREE CREEK					
At cross section A	4.5	840	1,200	1,400	1,800
LITTLE SEWICKLEY CREEK					
At the corporate limits	17.1	2,750	4,750	5,900	9,200

BEST COPY AVAILABLE

TABLE 1 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SEWICKLEY CREEK					
Approximately 1,000 feet downstream of the confluence with Buffalo Creek	103.92	9,040	14,650	17,250	26,800
At the confluence with Buffalo Run	90.35	8,040	13,100	15,180	23,700
At the confluence with Wilson Run	81.65	7,350	12,000	13,880	21,600
At the confluence with Jack's Run	74.66	6,790	11,120	12,990	20,200
At the confluence with Township Line Run	44.78	4,390	7,080	8,280	12,760
JACK'S RUN					
At the confluence of Sewickley Creek	28.70	2,980	4,790	5,600	8,610
At the confluence with Tributary No. 3	25.43	2,720	4,270	5,040	7,760
At the confluence with Slate Creek	21.66	2,360	3,750	4,380	6,780
At the confluence with Zeller's Run	10.20	1,230	1,940	2,260	3,510
At the confluence with Tributary No. 5	4.93	680	1,060	1,230	1,920
SLATE CREEK					
At the confluence of Jack's Run	7.68	970	1,520	1,770	2,730
Approximately 0.7 mile upstream of Reapier Road	6.36	830	1,290	1,500	2,320
Approximately 250 feet downstream of Township Route 865	4.71	640	990	1,150	1,790
At the upstream side of Roadman Lakes Bridge	3.20	450	710	830	1,280
TRIBUTARY NO. 2					
At the confluence of Jack's Run	1.12	180	290	330	540

BEST COPY AVAILABLE

TABLE 1 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
ZELLER'S RUN					
At the confulence of Jack's Run	1.20	150	240	270	420
TRIBUTARY NO. 5					
At the confluence of Jack's Run	2.59	140	220	250	390
TOWNSHIP LINE RUN					
At the confluence of Sewickley Creek	6.57	860	1,350	1,580	2,420
BELSON RUN					
At the confluence of Sewickley Creek	2.58	350	540	630	970

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

All stream cross sections, bridge and culvert geometries, and reference marks were field surveyed. Cross sections were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel roughness factors (Manning's "n") for the streams in the original study were determined by field inspection of the flood plain areas and comparison with similar streams (Reference 9). In the updated study, the Manning's "n" values used in the hydraulic computations for Sewickley Creek were verified by reproduction of the October 1954, March 1964, and June 1972 floods for which high-water marks were obtained and flow quantities calculated. Where high-water marks were not available, the channel and overbank "n" values for the streams in the updated study were

BEST COPY AVAILABLE

selected on the basis of field inspection and comparison with typical channels of known roughness. The channel "n" and overbank "n" values for the streams studied by detailed methods are shown in the following tabulation:

Stream	Channel "n"	Overbank "n"
Tributary No. 1	0.035	0.100
Tributary No. 3	0.045	0.080-0.110
Brush Creek	0.035-0.050	0.080-0.120
Tributary No. 4	0.020-0.045	0.090-0.110
Little Crabtree Creek	0.035-0.045	0.090-0.110
Crabtree Creek	0.045	0.090-0.110
Little Sewickley Creek	0.035-0.040	0.080-0.110
Sewickley Creek	0.025-0.045	0.040-0.100
Jack's Run	0.012-0.060	0.012-0.100
Slate Creek	0.035-0.040	0.070-0.100
Tributary No. 2	0.030-0.035	0.070-0.080
Zeller's Run	0.015-0.040	0.030-0.070
Tributary No. 5	0.027-0.035	0.070-0.080
Township Line Run	0.035-0.040	0.035-0.080
Belson Run	0.027-0.045	0.050-0.080

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 10). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Starting water-surface elevations for Tributary No. 1, Tributary No. 3, Brush Creek, the upstream section of Little Crabtree Creek, Crabtree Creek, Little Sewickley Creek, Sewickley Creek, Jack's Run, and Slate Creek were calculated using the slope/area method. Starting water-surface elevations for the downstream section of Little Crabtree Creek were taken from the flood profile for Crabtree Creek from the Flood Insurance Study for the Township of Unity (Reference 11). Starting water-surface elevations for Tributary No. 4 were taken from the flood profiles for Little Crabtree Creek. Coincidental flooding was justified in the upper Sewickley Creek Basin, resulting in the starting water-surface elevations for Tributary No. 2, Zeller's Run, Tributary No.5, Township Line Run, and Belson Run being taken from the main stream elevation at their confluences.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

BEST COPY AVAILABLE

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (Reference 12).

The flood boundaries for the streams in the updated study were delineated using maps supplied by the COE (Reference 13).

For the streams studied by approximate methods, the 100-year flood plain boundaries were delineated using topographic maps and field investigations (Reference 12).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain manage-

BEST COPY AVAILABLE

ment. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated in Table 2 at selected cross sections for the following streams: Tributary No. 1, Tributary No. 3, Little Crabtree Creek, Crabtree Creek, Brush Creek, Tributary No. 4, and Little Sewickley Creek.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway widths for Brush Creek, Little Crabtree Creek, and Crabtree Creek extend beyond the corporate limits.

In the updated study, floodways were taken from the COE Flood Plain Information study (Reference 7). In the COE study, floodways were only computed on Sewickley Creek, Jack's Run, and Slate Creek since encroachment has already occurred on these streams, and it was felt that the impacts from development would be more significant on these streams. The floodways for Zeller's Run and Tributary No. 5 were taken from the previously effective Flood Insurance Study for the Township of Hempfield (Reference 14). Cross sectional information was not available in the COE study; hence, there are no cross sections delineated and no Floodway Data Tables produced for the revised streams in the updated study.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 6.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Tributary No. 1								
A	905[1]	33	219	5.8	983.2	983.2	984.1	0.9
B	1,370[1]	31	183	6.0	984.2	984.2	985.1	0.9
C	2,995[1]	33	174	7.0	992.2	992.2	993.0	0.8
D	3,725[1]	63	345	4.9	1,000.5	1,000.5	1,000.5	0.0
E	4,370[1]	48	242	5.5	1,000.9	1,000.9	1,001.9	1.0
Tributary No. 3								
A	705[2]	30	160	6.8	1,041.8	1,041.8	1,042.5	0.7
B	1,305[2]	40	120	8.1	1,048.8	1,048.8	1,048.8	0.0
C	2,100[2]	27	158	7.1	1,058.2	1,058.2	1,058.4	0.2
D	3,020[2]	31	152	6.4	1,063.3	1,063.3	1,063.8	0.5
E	3,890[2]	46	220	4.9	1,070.5	1,070.5	1,070.5	0.0
F	4,740[2]	27	224	4.7	1,077.3	1,077.3	1,077.9	0.6
G	5,470[2]	23	119	8.9	1,079.9	1,079.9	1,080.8	0.9
H	6,060[2]	35	155	5.1	1,085.6	1,085.6	1,085.6	0.0
I	6,840[2]	55	281	2.8	1,091.2	1,091.2	1,091.5	0.3
J	7,470[2]	53	206	4.9	1,093.3	1,093.3	1,094.3	1.0
K	8,265[2]	32	141	4.9	1,097.2	1,097.2	1,097.6	0.4
L	8,469[2]	27	126	4.1	1,098.9	1,098.9	1,099.1	0.2

[1]Feet above confluence with Jack's Run
[2]Feet above mouth

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

FLOODWAY DATA

TRIBUTARY NO. 1 - TRIBUTARY NO. 3

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Little Crabtree Creek								
A	600	196/16	1,163	2.3	996.9	996.9	997.9	1.0
B	1,400	79/19	397	5.4	997.5	997.5	998.5	1.0
C	2,430	44/29	177	9.9	1,005.2	1,005.2	1,005.7	0.5
D	3,235	91/80	474	4.7	1,009.8	1,009.8	1,010.5	0.7
E	4,065	114/95	484	4.7	1,011.3	1,011.3	1,012.2	0.9
F	9,445	74/6	254	6.0	1,035.7	1,035.7	1,036.7	1.0
G	10,135	95/81	364	4.2	1,038.7	1,038.7	1,039.2	0.5
H	10,835	98/69	394	3.4	1,040.7	1,040.7	1,040.9	0.2
I	11,270	168/159	891	2.6	1,046.1	1,046.1	1,046.1	0.0
J	12,249	83/12	259	5.3	1,047.1	1,047.1	1,047.7	0.6
K	13,082	72/25	344	4.2	1,055.6	1,055.6	1,055.6	0.0
Crabtree Creek								
A	5,690	21/12	178	8.8	1,014.6	1,014.6	1,015.6	1.0
B	6,625	77/18	416	4.9	1,018.8	1,018.8	1,019.8	1.0
C	7,895	34/11	230	7.1	1,025.0	1,025.0	1,025.9	0.9
D	8,855	104/60	523	3.3	1,029.2	1,029.2	1,030.1	0.9
E	9,455	95/75	391	4.6	1,031.3	1,031.3	1,032.0	0.7
F	10,200	80/10	436	4.2	1,037.4	1,037.4	1,038.3	0.9

[1]Feet above mouth

[2]Width/width within corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

(WESTMORELAND CO.)

FLOODWAY DATA

LITTLE CRABTREE CREEK - CRABTREE CREEK

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Brush Creek								
A	3,370[1]	60/40[4]	569	8.2	935.5	935.5	935.5	0.0
B	4,265[1]	56/14[4]	592	8.0	941.5	941.5	941.5	0.0
C	390[2]	47/36[4]	423	7.1	1,005.2	1,005.2	1,005.2	0.0
D	1,127[2]	55/14[4]	312	9.4	1,008.1	1,008.1	1,008.1	0.0
E	1,627[2]	44/21[4]	252	9.6	1,009.3	1,009.3	1,010.1	0.8
F	2,493[2]	34/15[4]	209	13.2	1,015.0	1,015.0	1,015.1	0.1
G	3,214[2]	105/7[4]	390	10.2	1,022.6	1,022.6	1,023.4	0.8
H	3,814[2]	25/10[4]	164	14.8	1,026.9	1,026.9	1,026.9	0.0
I	3,985[2]	53/30[4]	336	8.2	1,028.7	1,028.7	1,029.5	0.8
J	308[3]	42/15[4]	227	7.1	1,070.6	1,070.6	1,071.6	1.0
K	1,210[3]	28/13[4]	144	11.6	1,080.5	1,080.5	1,080.8	0.3
L	1,895[3]	44/32[4]	242	8.2	1,088.2	1,088.2	1,088.8	0.6
M	2,585[3]	42/19[4]	269	6.5	1,095.9	1,095.9	1,096.6	0.7
N	3,484[3]	21/9[4]	142	11.4	1,101.4	1,101.4	1,102.3	0.9
Tributary No. 4								
A	675[1]	18	66	8.1	1,059.8	1,059.8	1,060.1	0.3
B	1,205[1]	22	104	5.9	1,066.7	1,066.7	1,067.0	0.3
C	1,950[1]	23	120	1.9	1,077.5	1,077.5	1,077.5	0.0
D	2,435[1]	15	34	6.3	1,084.8	1,084.8	1,084.9	0.1
E	3,035[1]	14	37	6.8	1,095.9	1,095.9	1,096.7	0.8

[1]Feet above mouth

[2]Feet above corporate limits

[3]Feet above State Route 766

[4]Width/width within corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

(WESTMORELAND CO.)

FLOODWAY DATA

BRUSH CREEK -- TRIBUTARY NO. 4

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Little Sewickley Creek								
A	1,942	92	853	9.8	937.3	937.3	938.3	1.0
B	2,794	207	1,972	4.9	940.2	940.2	941.1	0.9
C	3,431	316	2,718	3.5	940.9	940.9	941.9	1.0
D	4,334	322	2,373	4.1	941.6	941.6	942.6	1.0

[1]Feet above corporate limits

BEST COPY AVAILABLE

TABLE 2

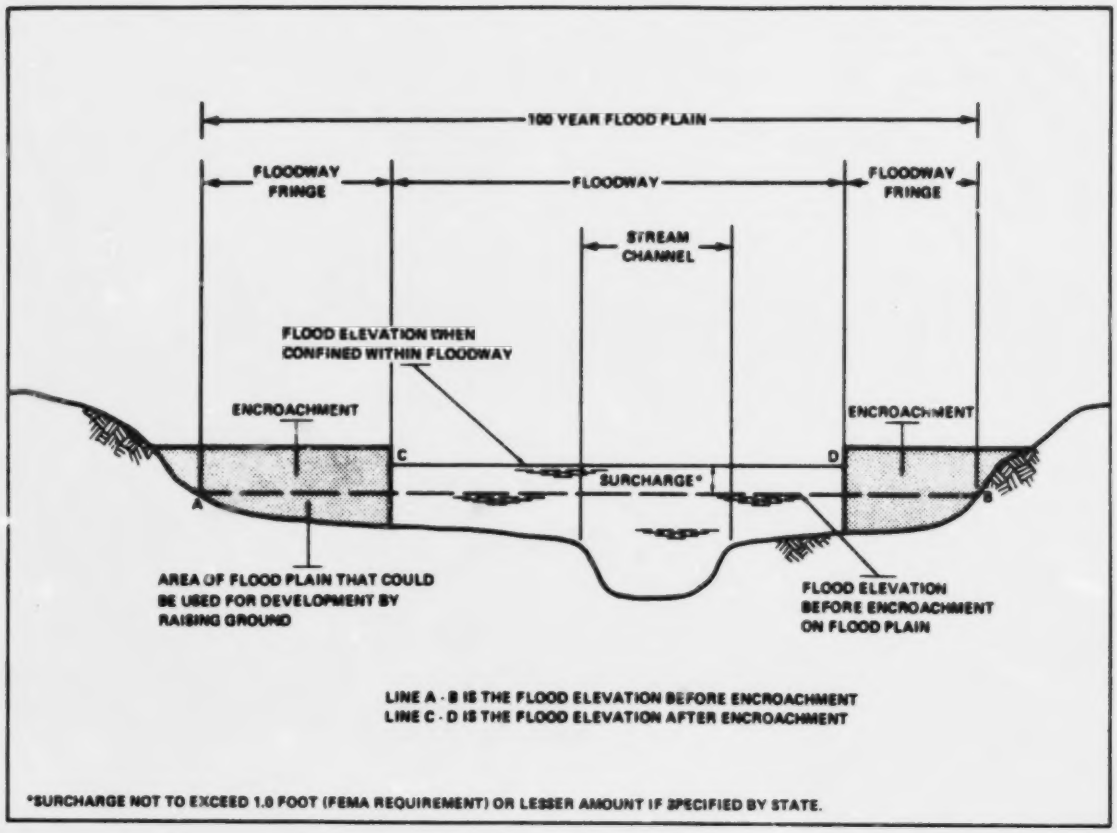
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

(WESTMORELAND CO.)

FLOODWAY DATA

LITTLE SEWICKLEY CREEK


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC

Figure 6

determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail in the Township of Hempfield.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

BEST COPY AVAILABLE

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the Township of Hempfield are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A2, A3, A4, A5, A6, A7, A8, A9, A11, and A12:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike,

BEST COPY AVAILABLE

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Tributary No. 1							
Reach 1	15	-1.8	-0.5	+1.1	020	A4	Varies
Reach 2	15	-0.9	-0.2	+0.6	010	A2	Varies
Reach 3	15	-2.4	-0.7	+2.3	025	A5	Varies
Tributary No. 3							
Reach 1	10,15	-1.7	-0.6	+1.1	015	A3	Varies
Brush Creek							
Reach 1	10	-3.6	-1.2	+1.8	035	A7	Varies
Reach 2	10	-2.5	-1.1	+1.6	025	A5	Varies
Reach 3	10	-5.3	-2.2	+0.7	055	A11	Varies
Reach 4	10	-2.4	-0.6	+1.5	025	A5	Varies
Reach 5	05	-1.7	-0.6	+1.0	015	A3	Varies
Tributary No. 4							
Reach 1	05	-1.1	-0.5	+0.9	010	A2	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

FLOOD INSURANCE ZONE DATA

TRIBUTARY NO. 1 - TRIBUTARY NO. 3
BRUSH CREEK - TRIBUTARY NO. 4

BEST COPY AVAILABLE

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Little Crabtree Creek							
Reach 1	05	-1.8	-0.5	+1.2	020	A4	Varies
Reach 2	05	-1.4	-0.4	+0.5	015	A3	Varies
Crabtree Creek							
Reach 1	05	-1.4	-0.4	+0.9	015	A3	Varies
Little Sewickley Creek							
Reach 1	20	-3.8	-1.3	+3.5	040	A8	Varies
Sewickley Creek							
Reach 1	25	-6.0	-1.3	+4.2	060	A12	Varies
Reach 2	25	-4.3	-1.2	+3.4	045	A9	Varies
Jack's Run							
Reach 1	05, 15, 25	-3.1	-1.0	+3.3	030	A6	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

BEST COPY AVAILABLE

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

FLOOD INSURANCE ZONE DATA

LITTLE CRABTREE CREEK - CRABTREE CREEK
LITTLE SEWICKLEY CREEK - SEWICKLEY CREEK
JACK'S RUN

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Slate Creek							
Reach 1	05,15	-1.6	-0.4	+1.2	015	A3	Varies
Tributary No. 2							
Reach 1	05	-1.3	-0.5	+0.9	015	A3	Varies
Zeller's Run							
Reach 1	15	-0.9	-0.3	+0.4	010	A2	Varies
Reach 2	15	-1.0	-0.3	+0.6	010	A2	Varies
Reach 3	15	-2.3	-0.4	+0.8	025	A5	Varies
Tributary No. 5							
Reach 1	05,15	-1.1	-0.3	+0.6	010	A2	Varies
Township Line Run							
Reach 1	25	-3.7	-0.7	+2.4	035	A7	Varies
Reach 2	15,25	-1.2	-0.4	+0.9	010	A2	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

BEST COPY AVAILABLE

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

FLOOD INSURANCE ZONE DATA

SLATE CREEK - TRIBUTARY NO. 2 - ZELLER'S RUN
TRIBUTARY NO. 5 - TOWNSHIP LINE RUN

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Belson Run							
Reach 1	25	-6.0	-1.3	+4.2	060	A12	Varies
Reach 2	25	-0.8	-0.3	+0.6	010	A2	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

FLOOD INSURANCE ZONE DATA

BELSON RUN

BEST COPY AVAILABLE

Zone B:
(continued) levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Hempfield is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

Flood Insurance Studies for the the Township of Sewickley and the City of Jeannette have been published (References 15 and 16). The results of those studies are in complete agreement with the results of this study for Hempfield.

Flood Insurance Studies for the Township of Unity, the Township of Mount Pleasant, the City of Greensburg, and the Township of North Huntingdon are currently being revised (References 11, 17, 18, and 19). The results of those studies will be in complete agreement with the results of this study.

In 1967, the COE produced a Flood Plain Information Report for Sewickly Creek and Jack's Run in the Township of Hempfield (Reference 20). The hydrologic analysis used in the COE study has been greatly influenced by recent floods; therefore, it was necessary to update the analysis with a newer and longer period of record. The 100-year elevations used in the COE report were 1.0 to 5.8 feet lower than those used in this study. The information used in this study supersedes the previous COE report due to its more up-to-date analysis.

BEST COPY AVAILABLE

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region III Office, Curtis Building, Room 700, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

8.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Climatological Data for Pennsylvania, Washington, D. C., 1974.

2. U. S. Department of Agriculture, Soil Conservation Service, Soil Survey, Westmoreland County, Pennsylvania, Washington, D. C., 1968.

3. U. S. Department of Commerce, Bureau of the Census, 1970 Census of Population, Number of Inhabitants, Pennsylvania, Washington, D. C., U. S. Government Printing Office, 1971.

4. Water Resources Council, "Guidelines for Determining Flood Flow Frequency," Bulletin 17, Washington, D. C., March 1976.

5. Pennsylvania Department of Environmental Resources, Floods in Pennsylvania, Frequency and Magnitude by L. C. Shaw and W. F. Busch, Pennsylvania, 1960.

6. The Pennsylvania State University, Institute for Research on Land and Water Resources, PSU III, Flood Peak Frequency Design Manual by B. M. Reich, Y. P. King, and E. L. White, University Park, Pennsylvania, 1971.

7. U. S. Army Corps of Engineers, Pittsburg District, Expanded Flood Plain Information, Upper Sewickley Creek Basin, Westmoreland County, Pennsylvania, Pittsburgh, Pennsylvania, October 1980.

8. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-1 Flood Hydrograph Package, Davis, California, October 1970.

9. U. S. Department of the Interior, Geological Survey, Water-Supply Paper 1849, Roughness Characteristics of Natural Channels by Harry H. Barnes, Jr., Washington, D. C., 1967.

10. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Users Manual, Davis, California, October 1973.

11. Federal Emergency Management Agency, Flood Insurance Study, Township of Unity, Westmoreland County, Pennsylvania (Unpublished).

BEST COPY AVAILABLE

12. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Smithton, Pennsylvania, 1954, Photorevised 1969; Irwin, Pennsylvania, 1953, Photorevised 1969; Greensburg, Pennsylvania, 1954, Photorevised 1969; Mount Pleasant, Pennsylvania, 1964, Photorevised 1973; Latrobe, Pennsylvania, 1964, Photorevised 1973.

13. U. S. Army Corps of Engineers, Pittsburg District, Expanded Flood Plain Information, Upper Sewickley Creek Basin, Westmoreland County, Pennsylvania, Appendix F, Scale 1:2,400, Contour Interval 4 Feet, Pittsburg, Pennsylvania, October 1980.

14. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Township of Hempfield, Westmoreland County, Pennsylvania, Washington, D. C., September 29, 1978.

15. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Township of Sewickley, Westmoreland County, Pennsylvania, Washington, D. C., June 1, 1978.

16. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Jeannette, Westmoreland County, Pennsylvania, Washington, D. C., April 17, 1978.

17. Federal Emergency Management Agency, Flood Insurance Study, Township of Mount Pleasant, Westmoreland County, Pennsylvania (Unpublished).

18. Federal Emergency Management Agency, Flood Insurance Study, City of Greensburg, Westmoreland County, Pennsylvania (Unpublished).

18. Federal Emergency Management Agency, Flood Insurance Study, Township of North Huntingdon, Westmoreland County, Pennsylvania (Unpublished).

20. U. S. Army Corps of Engineers, Flood Plain Information Report, Sewickley Creek and Jack's Run, Hempfield Township, Pennsylvania, Pittsburgh, March 1967.

Chow, Ven Te, ed., Handbook of Applied Hydrology, New York, McGraw-Hill, 1964.

Department of Commerce, Bureau of Statistics, Research and Planning, Pennsylvania County Industry Report, Westmoreland County, Harrisburg, Pennsylvania, 1972.

Linsley, Ray K., Max A. Kohler, and Joseph L. H. Paulus, Hydrology for Engineers, New York, McGraw-Hill, 1958.

BEST COPY AVAILABLE

Pennsylvania Department of Environmental Resources, Pennsylvania Gazetteer of Streams, Part I by L. C. Shaw and W. F. Busch, Harrisburg, Pennsylvania, 1971.

Pennsylvania Office of Planning and Development, Flood Plain Information for the Commonwealth of Pennsylvania, Volume 5, Ohio River Basin, Beaver, Pennsylvania, November 1974.

U. S. Army Corps of Engineers, Hydrologic Engineering Center, Application of the HEC-2 Bridge Routines, Training Document No. 6, Davis, California, June 1974.

U. S. Army Corps of Engineers, Hydrologic Engineering Center, Floodway Determination Using Computer Program HEC-2, Training Document No. 5, Davis, California, May 1974.

U. S. Army Corps of Engineers, Hydrologic Engineering Center, Hydrologic Frequency Analysis, Davis, California, April 1975.

U. S. Army Corps of Engineers, Post Flood Report, Tropical Storm Agnes, Volumes I, II, Pittsburgh, Pennsylvania, 1974.

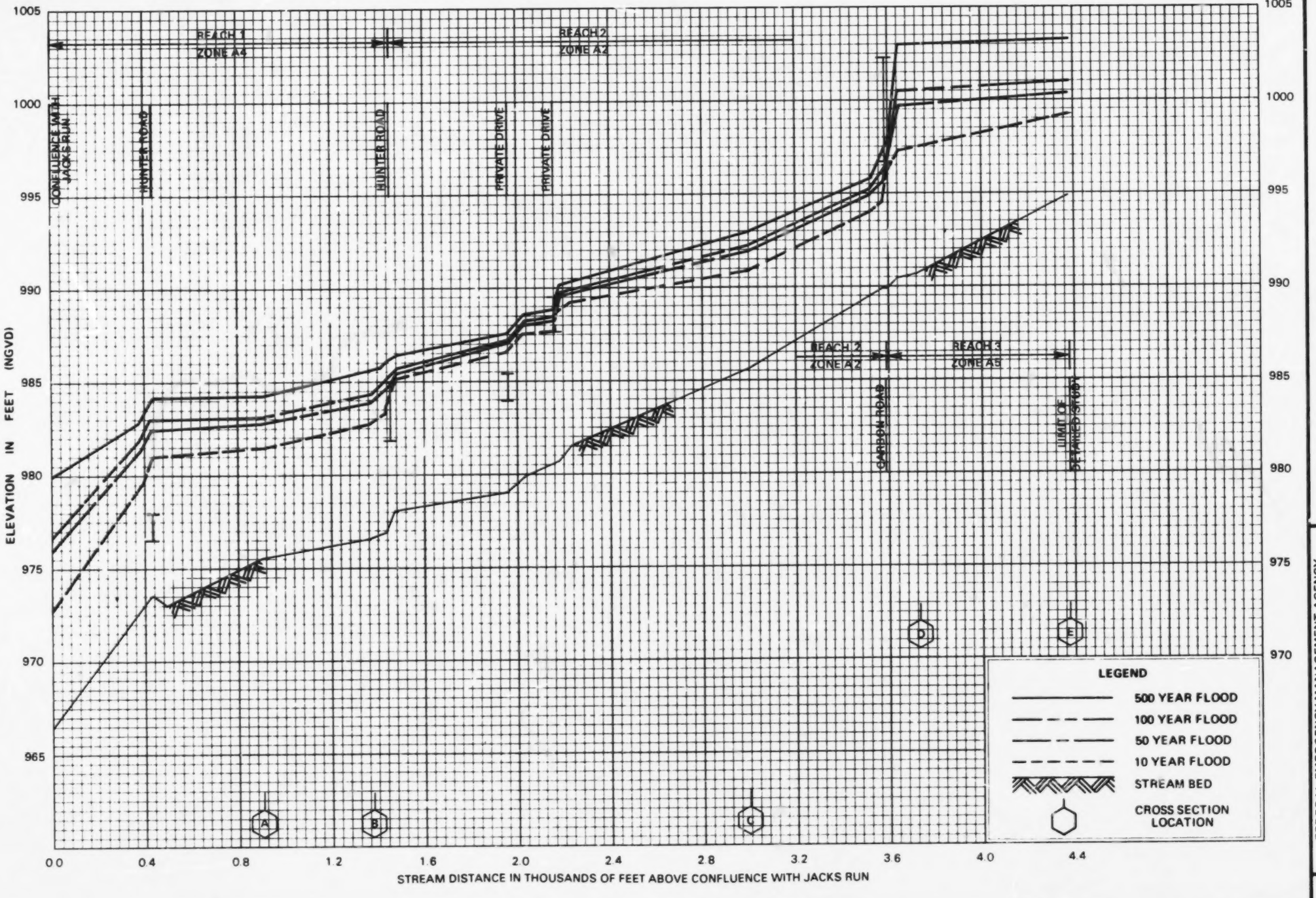
U. S. Department of Agriculture, Soil Conservation Service, Technical Release No. 55, Urban Hydrology for Small Watersheds, Washington, D. C., January 1975.

U. S. Department of the Interior, Geological Survey, in cooperation with the Pennsylvania Department of Forests and Waters, Elevations of Major Floods Along Pennsylvania Rivers, Harrisburg, Pennsylvania, 1942.

U. S. Department of the Interior, Geological Survey, Water Resources Data for Pennsylvania, Part 1, Surface Water Records, 1961-1975, Harrisburg, Pennsylvania, 1975.

U. S. Department of the Interior, Geological Survey, Water-Supply Paper 1675, Magnitude and Frequency of Floods in the United States, Part 3-A, Ohio River Basin Except Cumberland and Tennessee River Basins, Washington, D. C., 1965.

BEST COPY AVAILABLE



FLOOD PROFILES

TRIBUTARY NUMBER 1

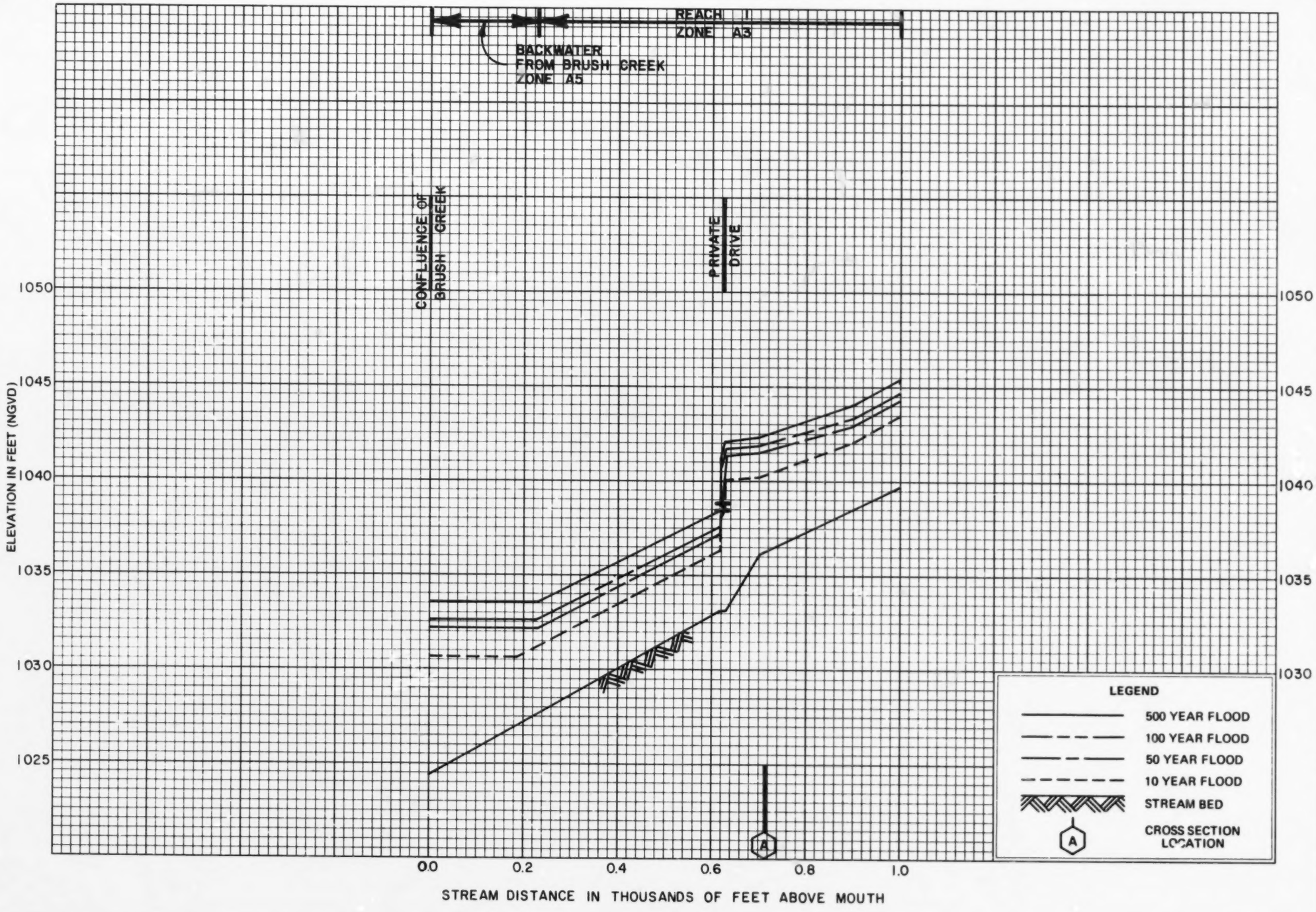
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

(WESTMORELAND CO.)

01P

BEST COPY AVAILABLE



FLOOD PROFILES

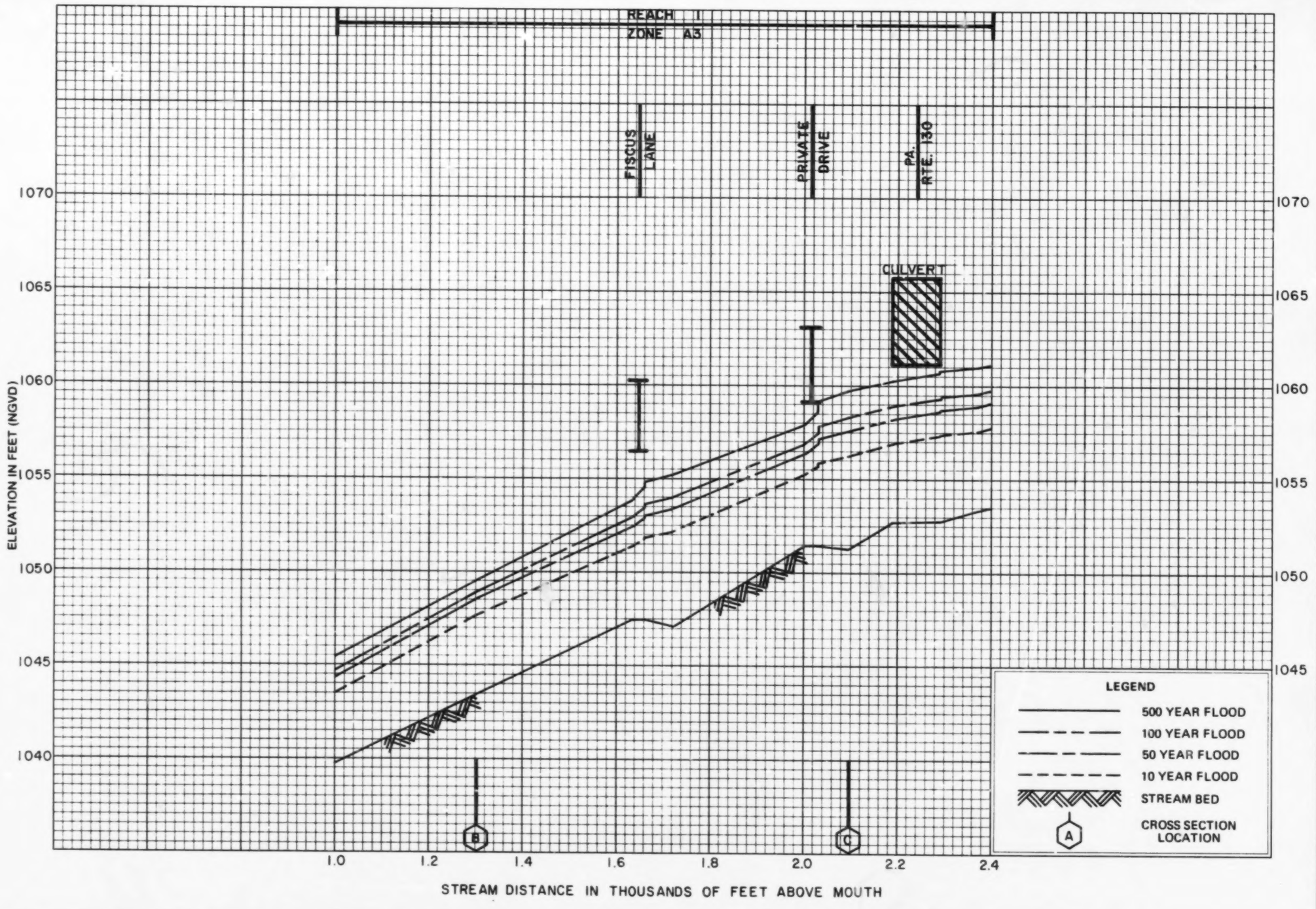
TRIBUTARY NUMBER 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

02P

BEST COPY AVAILABLE



FLOOD PROFILES

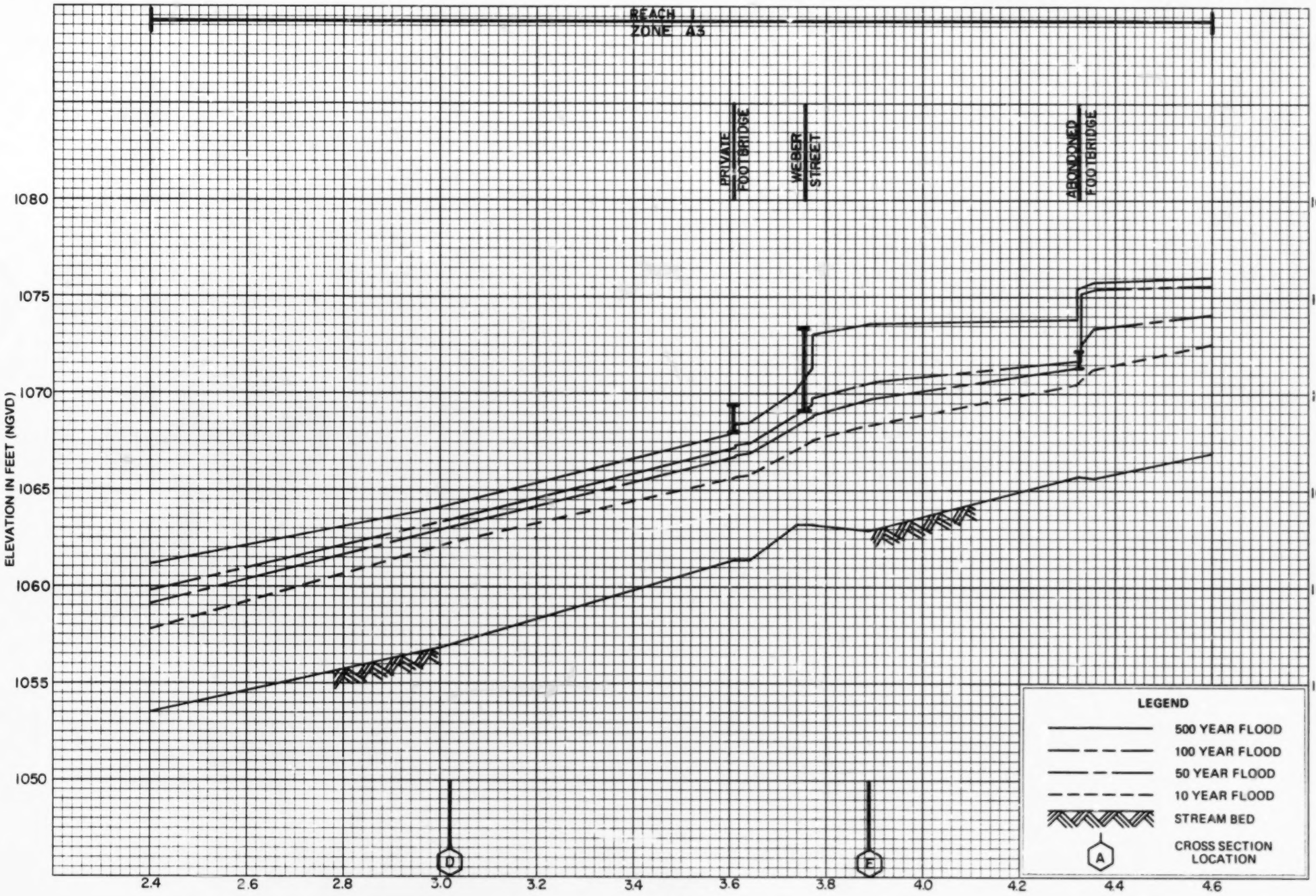
TRIBUTARY NUMBER 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

03P

BEST COPY AVAILABLE



FLOOD PROFILES

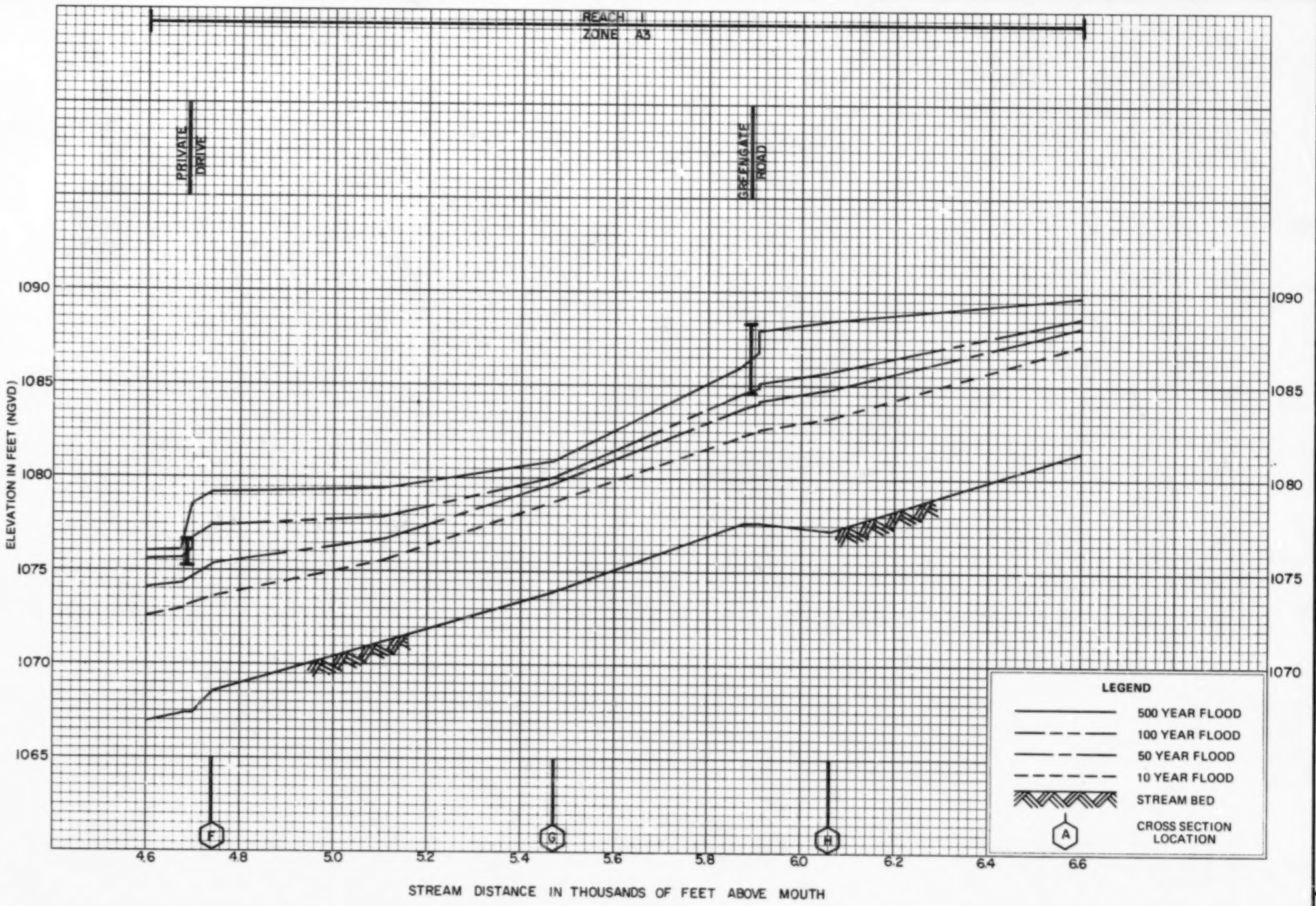
TRIBUTARY NUMBER 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

04P

BEST COPY AVAILABLE



FLOOD PROFILES

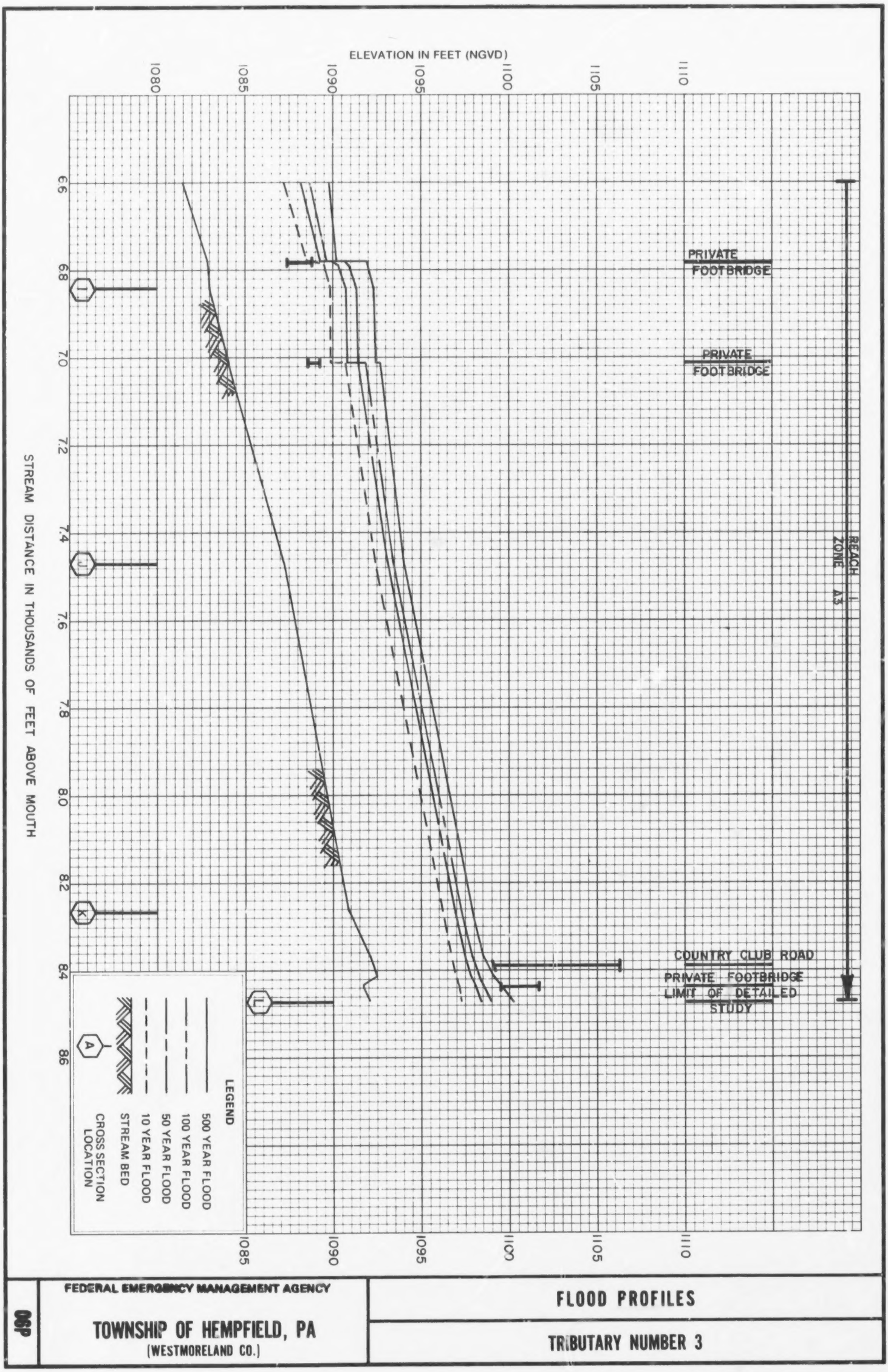
TRIBUTARY NUMBER 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

05P

BEST COPY AVAILABLE



FEDERAL EMERGENCY MANAGEMENT AGENCY

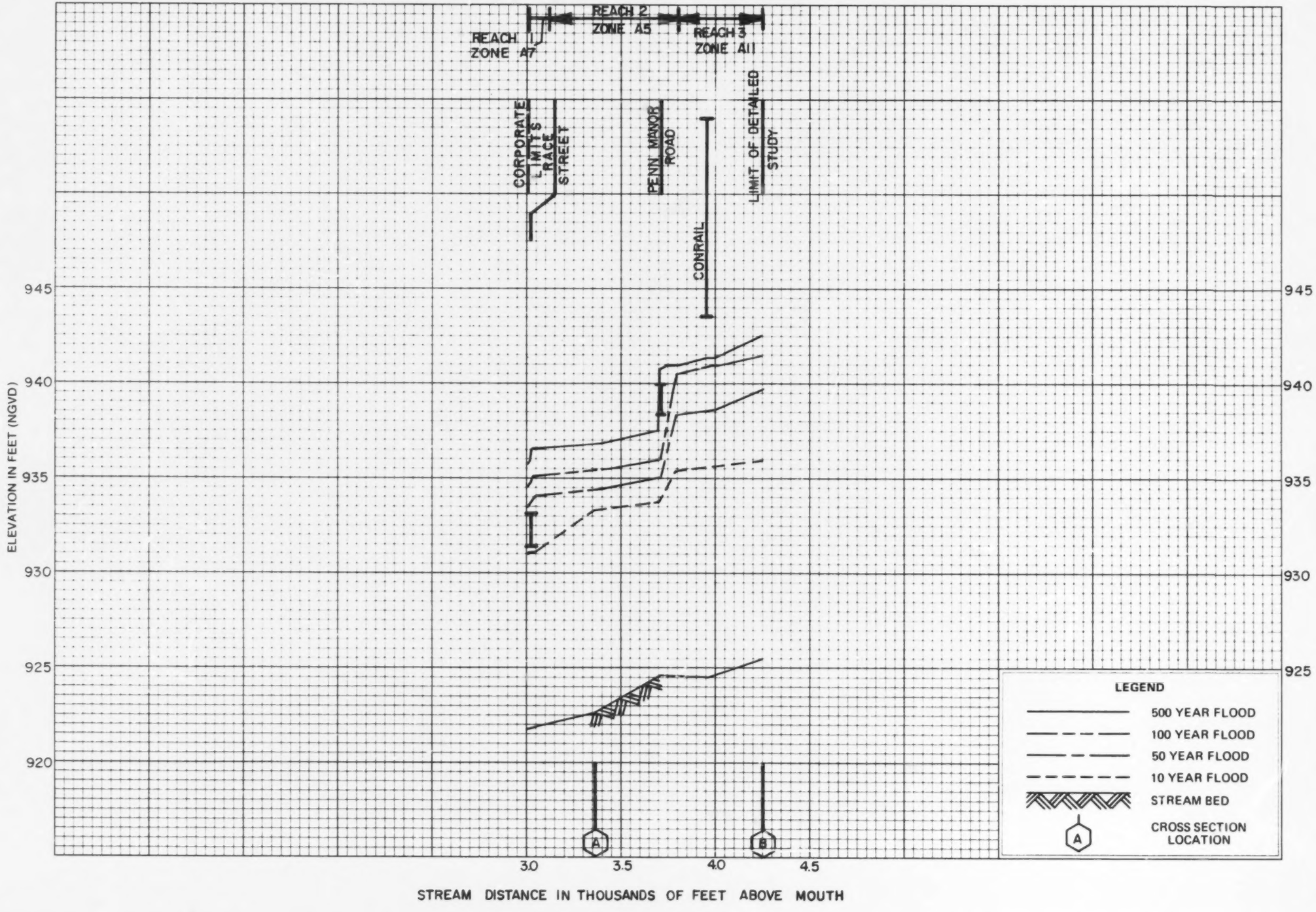
OSP

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

FLOOD PROFILES

TRIBUTARY NUMBER 3

BEST COPY AVAILABLE



FLOOD PROFILES

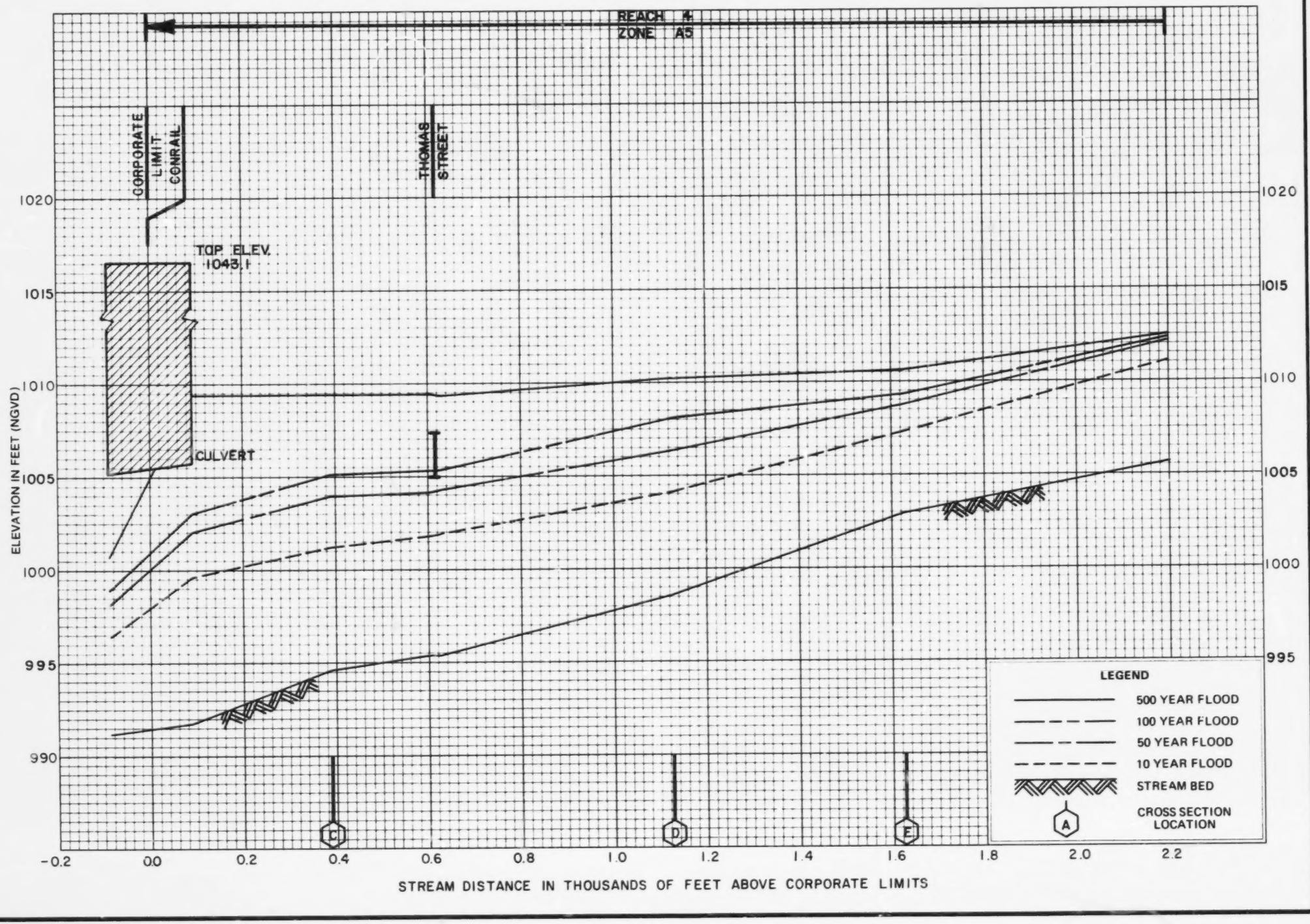
BRUSH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

07P

BEST COPY AVAILABLE



FLOOD PROFILES

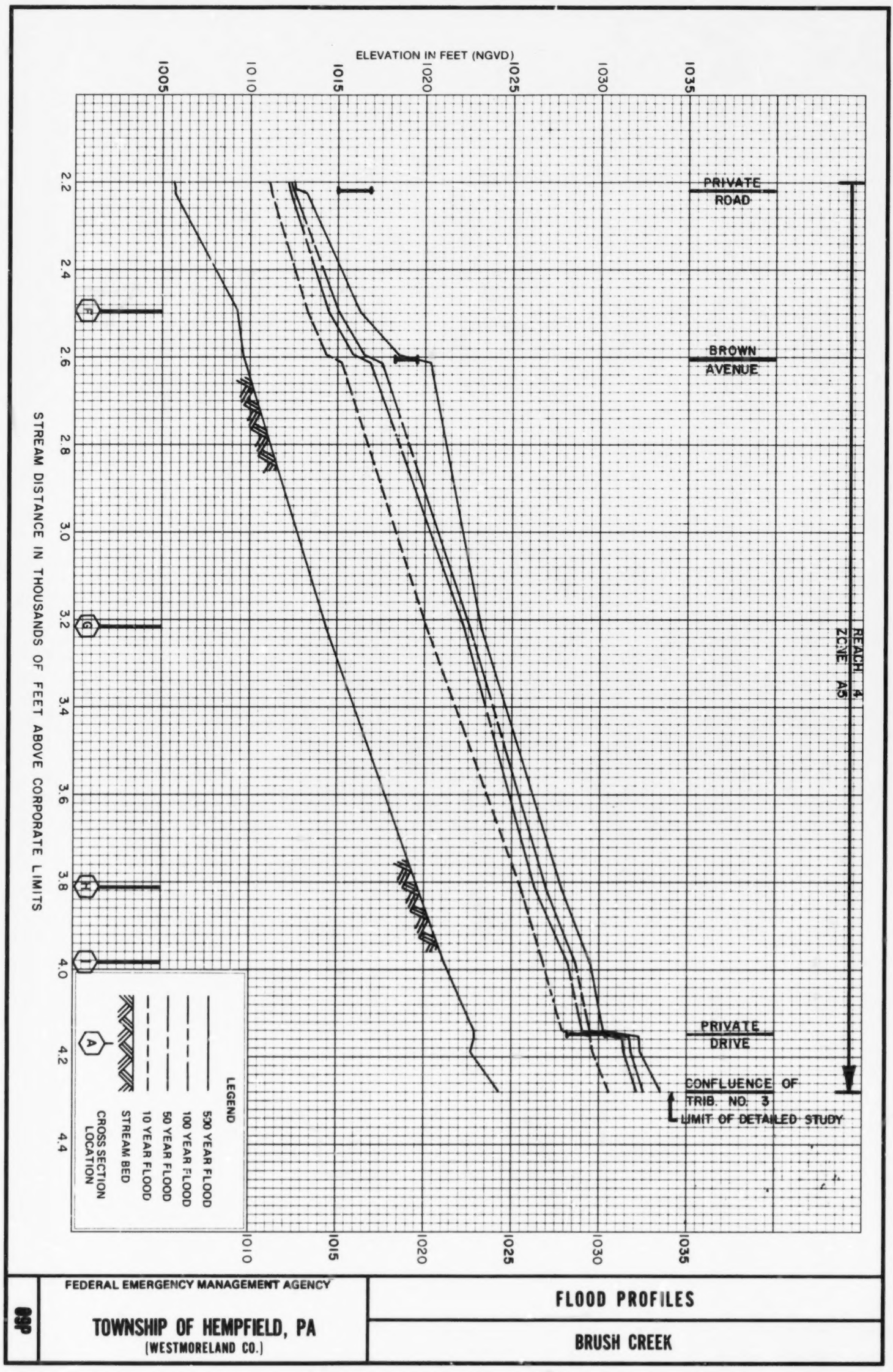
BRUSH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

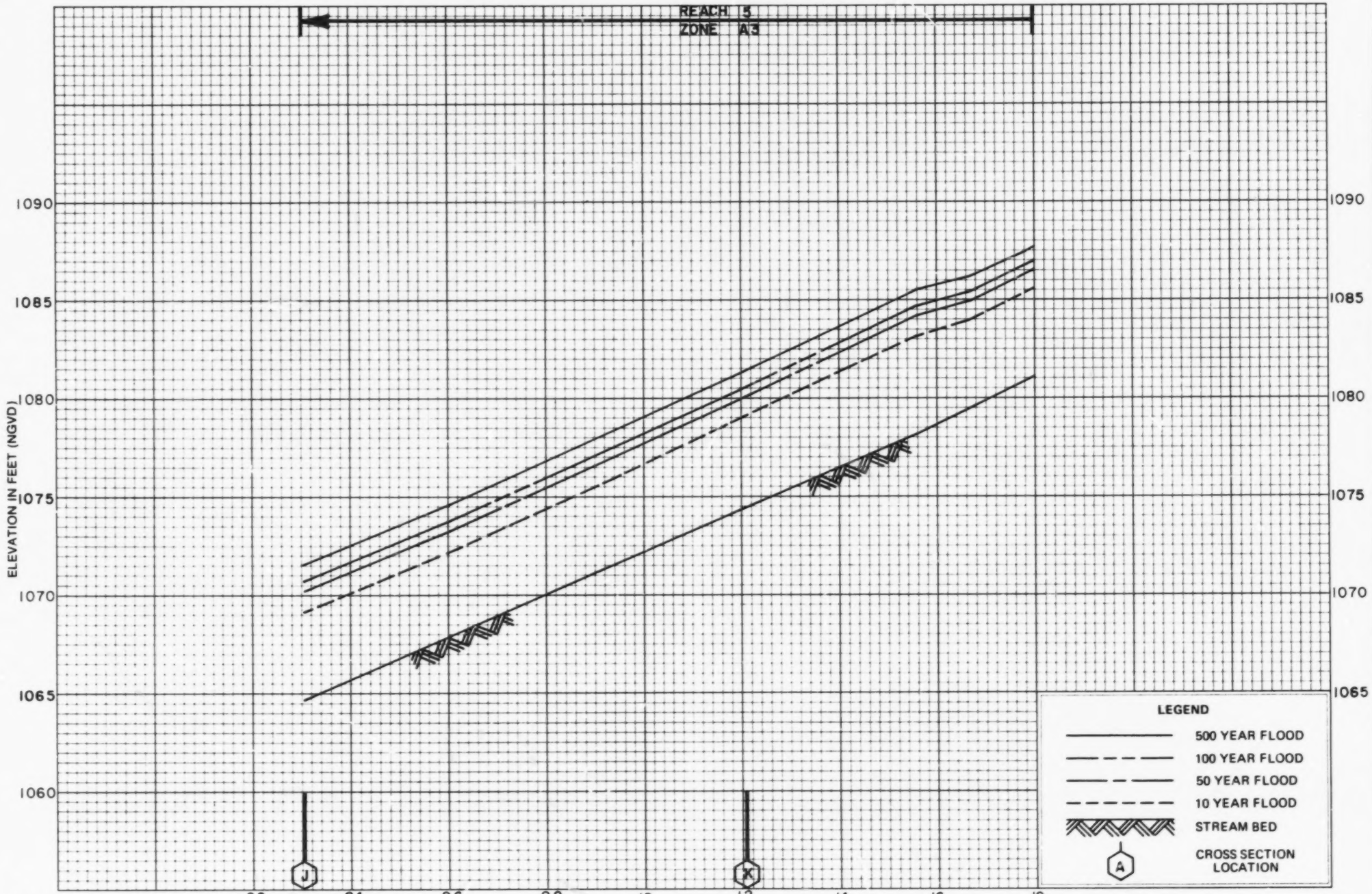
TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

08P

BEST COPY AVAILABLE



BEST COPY AVAILABLE



FLOOD PROFILES

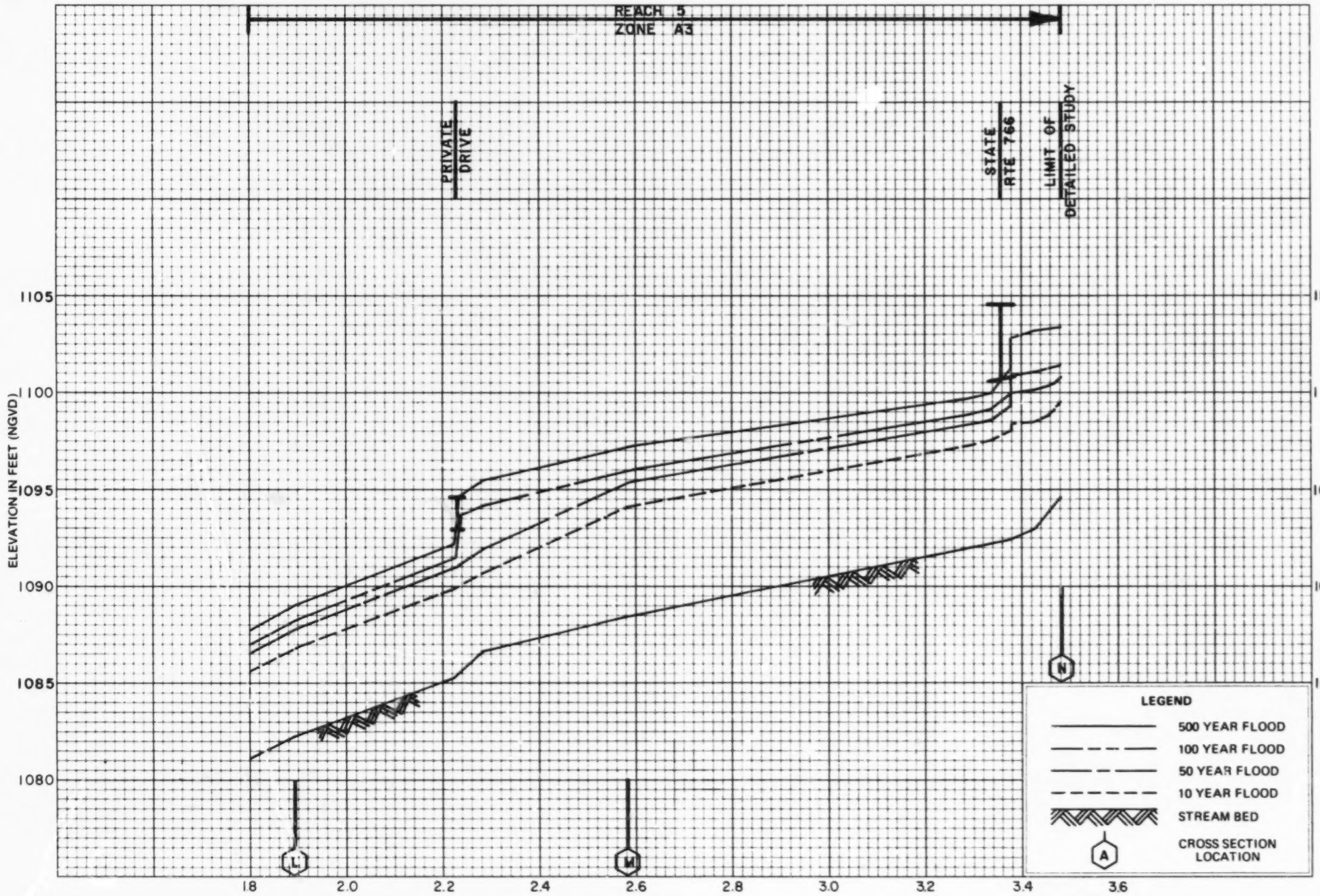
BRUSH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

10P

BEST COPY AVAILABLE



FLOOD PROFILES

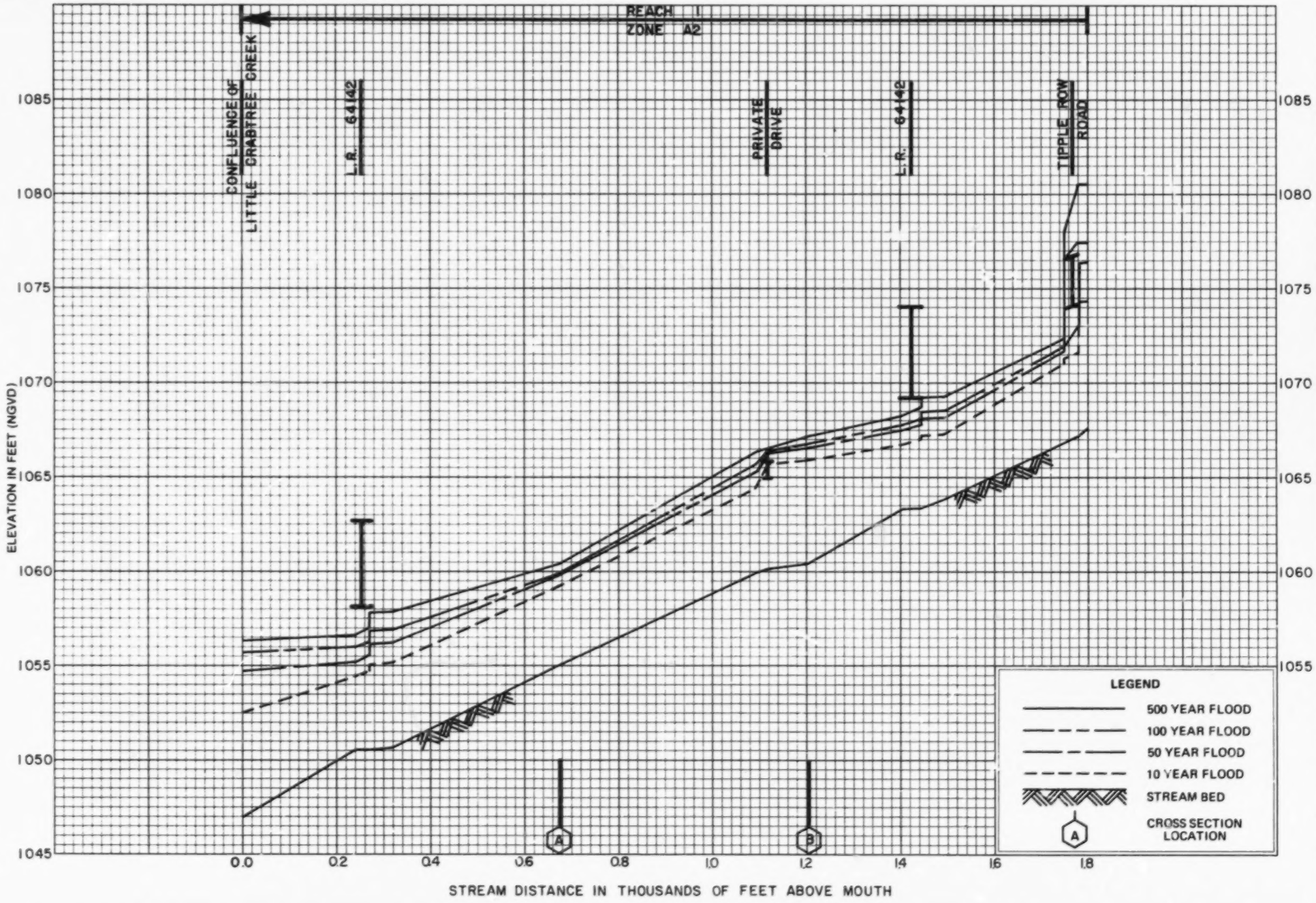
BRUSH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

11P

BEST COPY AVAILABLE



FLOOD PROFILES

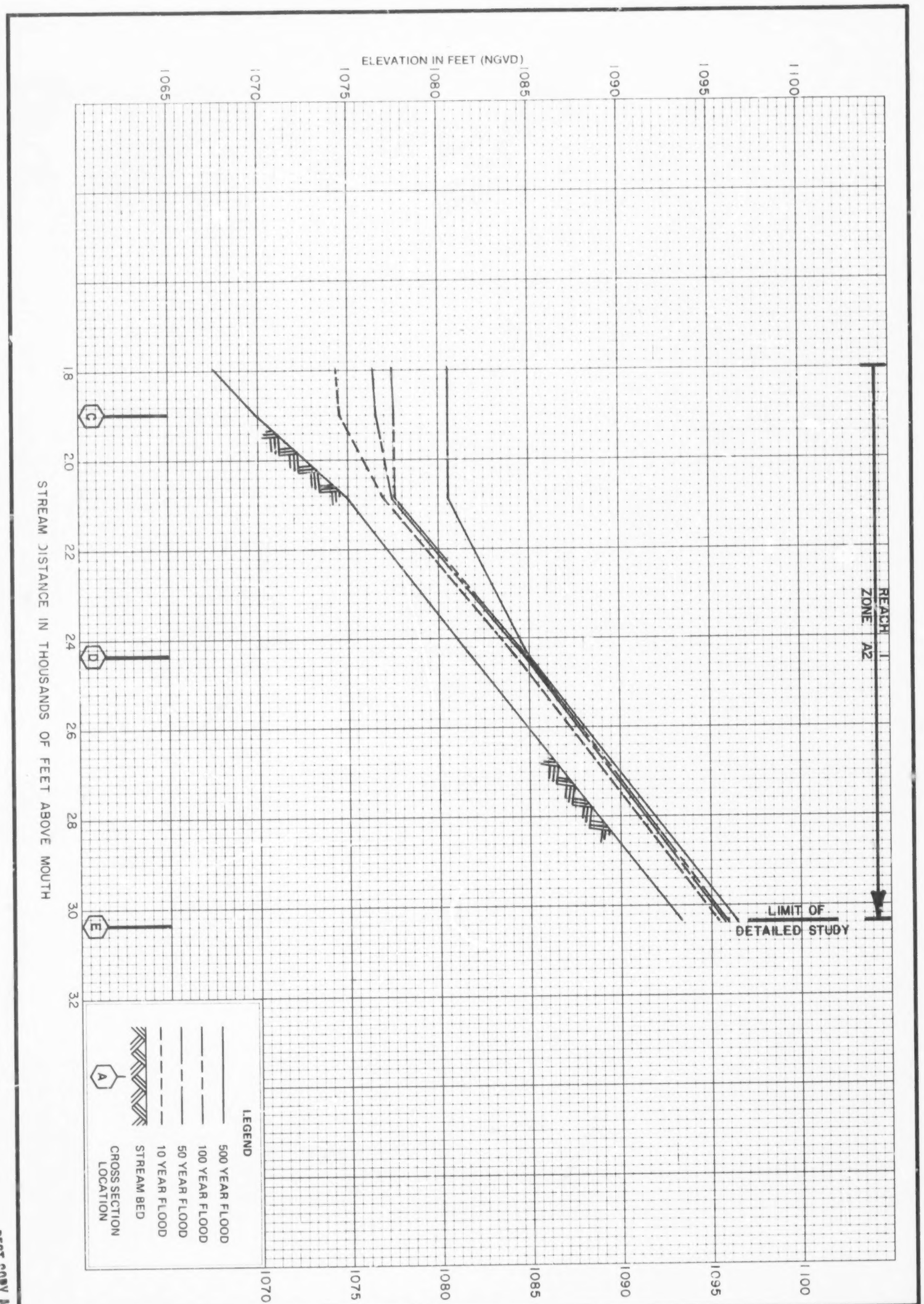
TRIBUTARY NUMBER 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFELD, PA
(WESTMORELAND CO.)

12P

BEST COPY AVAILABLE



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

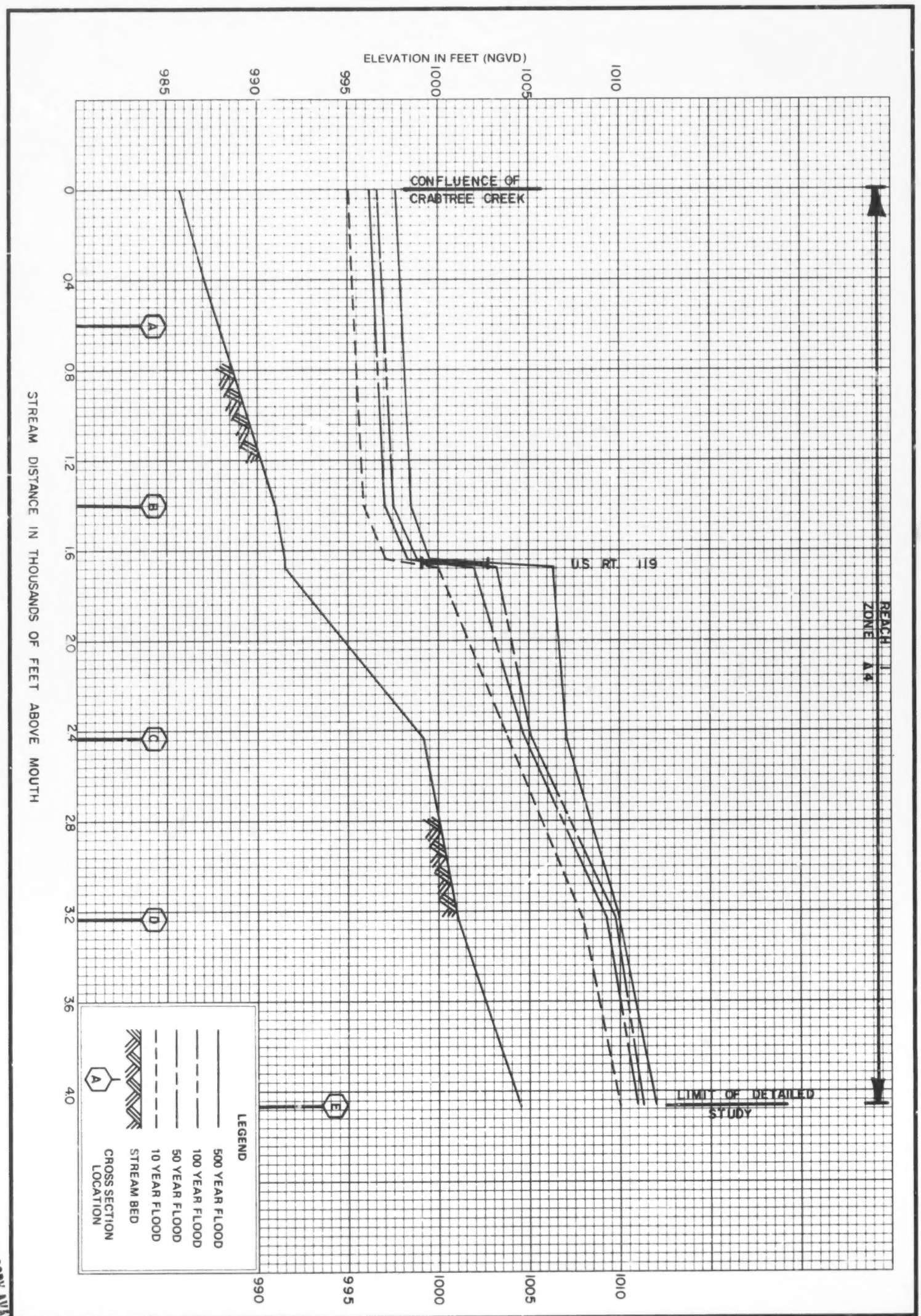
FLOOD PROFILES

TRIBUTARY NUMBER 4

13P

43

BEST COPY AVAILABLE



FEDERAL EMERGENCY MANAGEMENT AGENCY

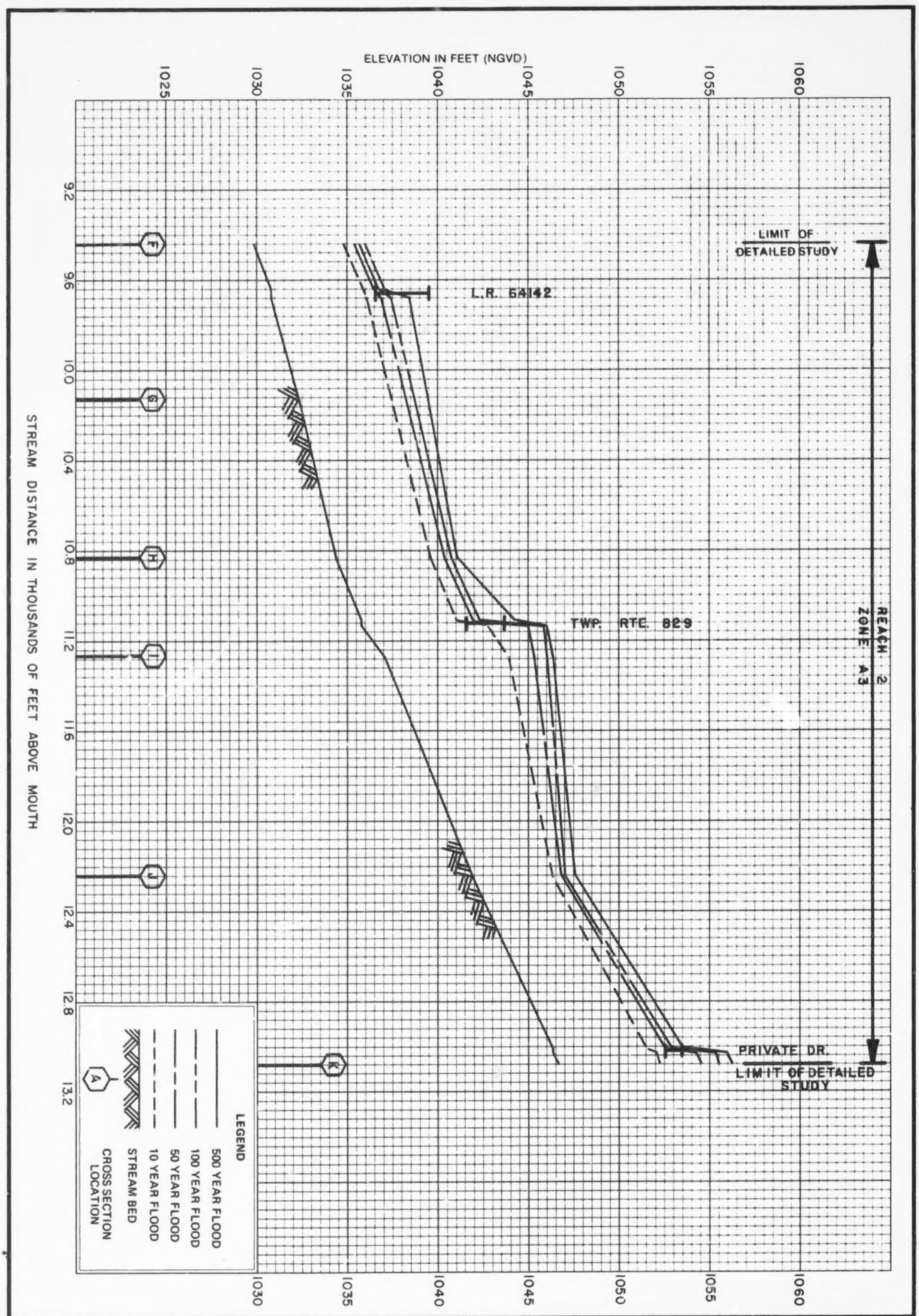
TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

FLOOD PROFILES

LITTLE CRABTREE CREEK

14P

BEST COPY AVAILABLE



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

FLOOD PROFILES

LITTLE CRABTREE CREEK

15P

45

BEST COPY AVAILABLE

FLOOD PROFILES

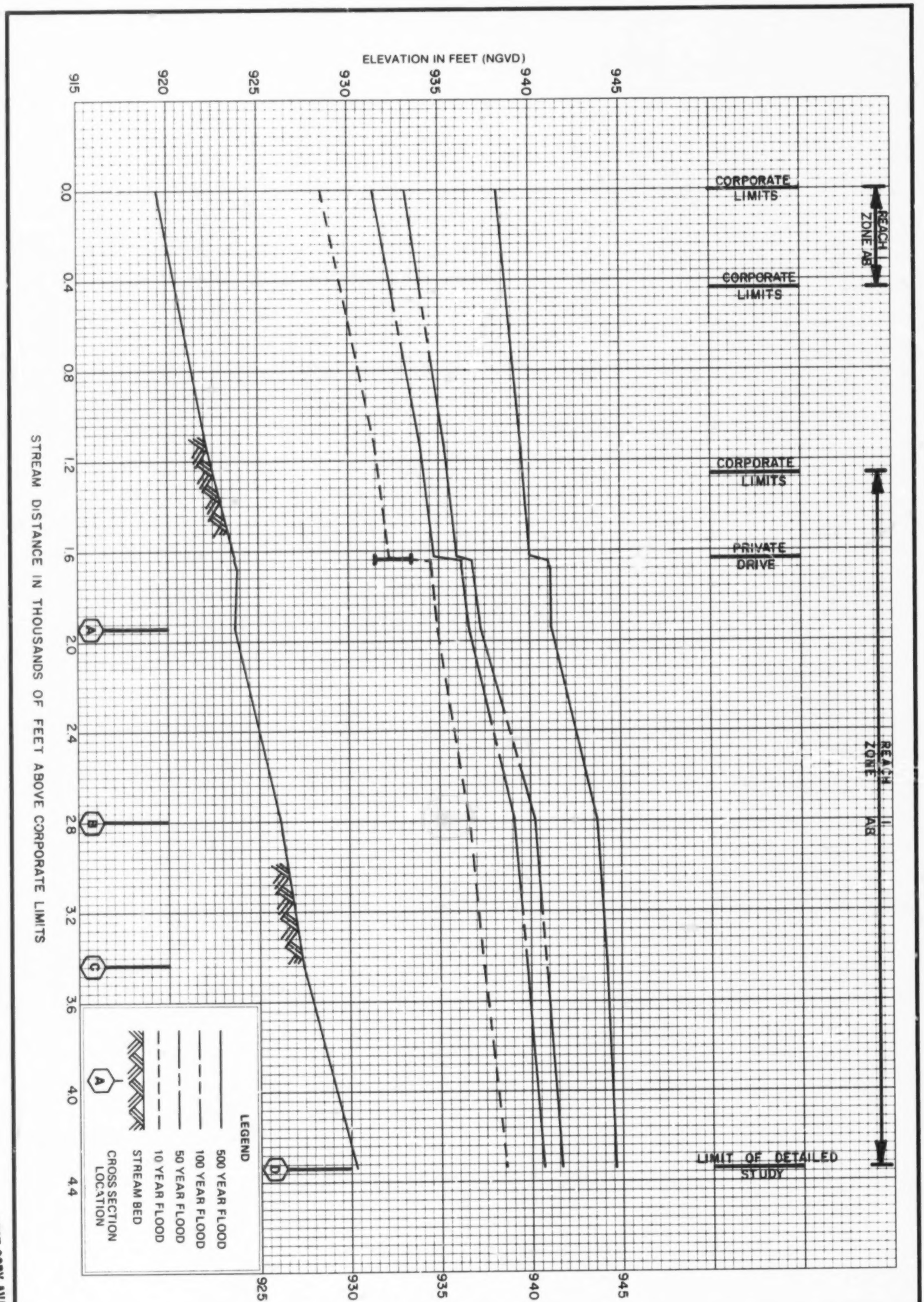
CRABTREE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFELD, PA
(WESTMORELAND CO.)

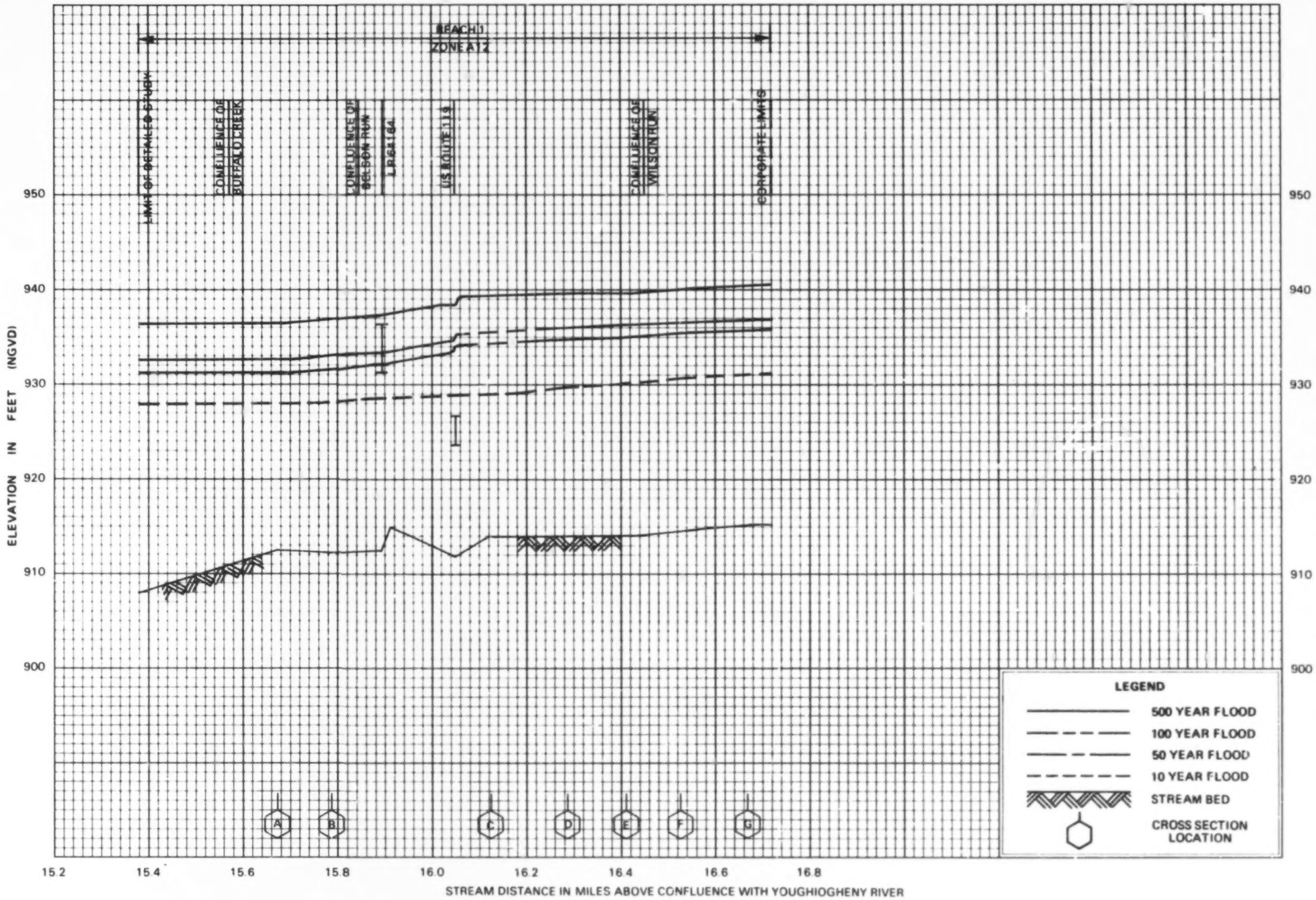
16P

BEST COPY AVAILABLE



17P	FEDERAL EMERGENCY MANAGEMENT AGENCY TOWNSHIP OF HEMPFIELD, PA (WESTMORELAND CO.)	FLOOD PROFILES LITTLE SEWICKLEY CREEK

BEST COPY AVAILABLE



FLOOD PROFILES

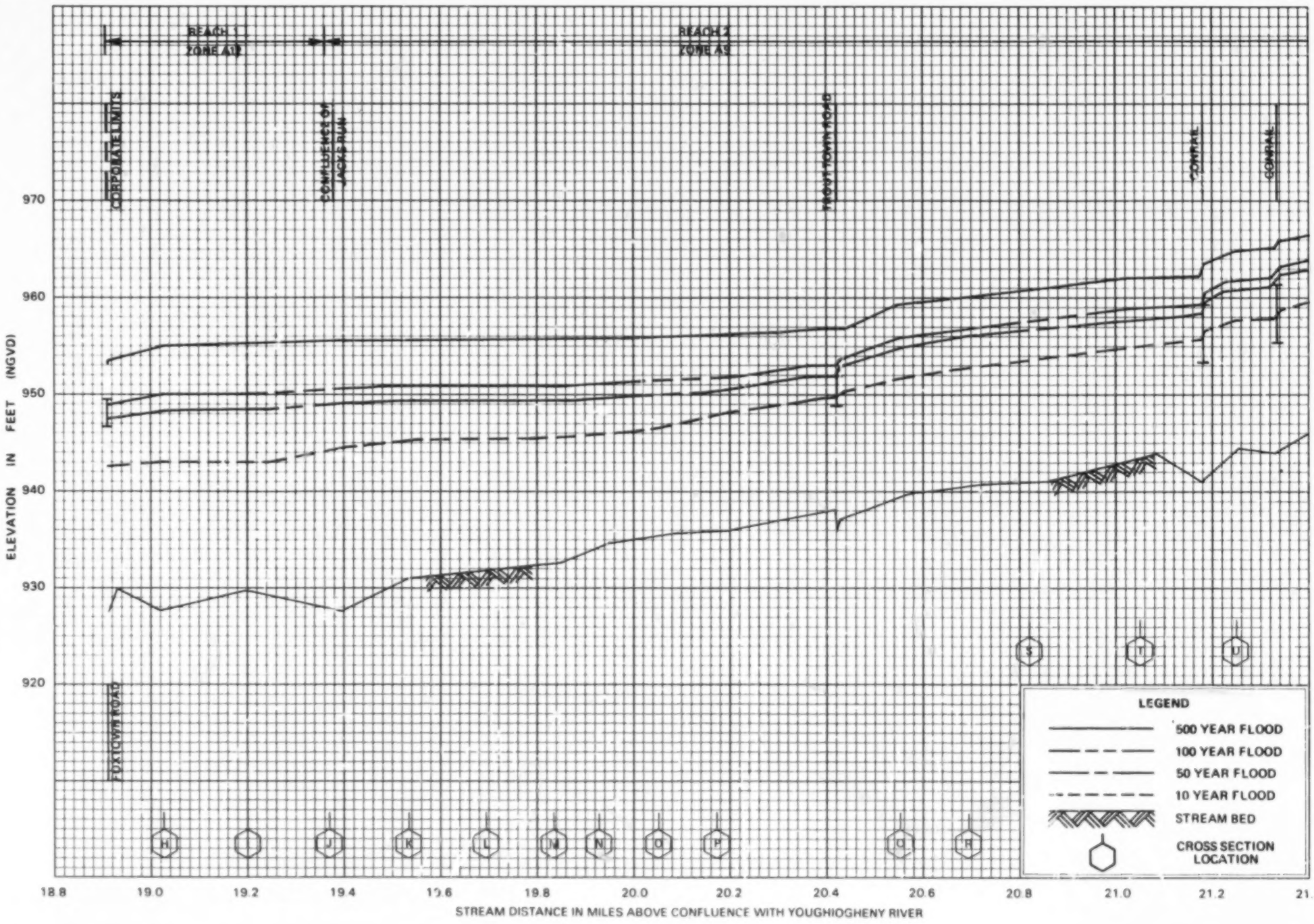
SEWICKLEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

18P

BEST COPY AVAILABLE



FLOOD PROFILES

SEWICKLEY CREEK

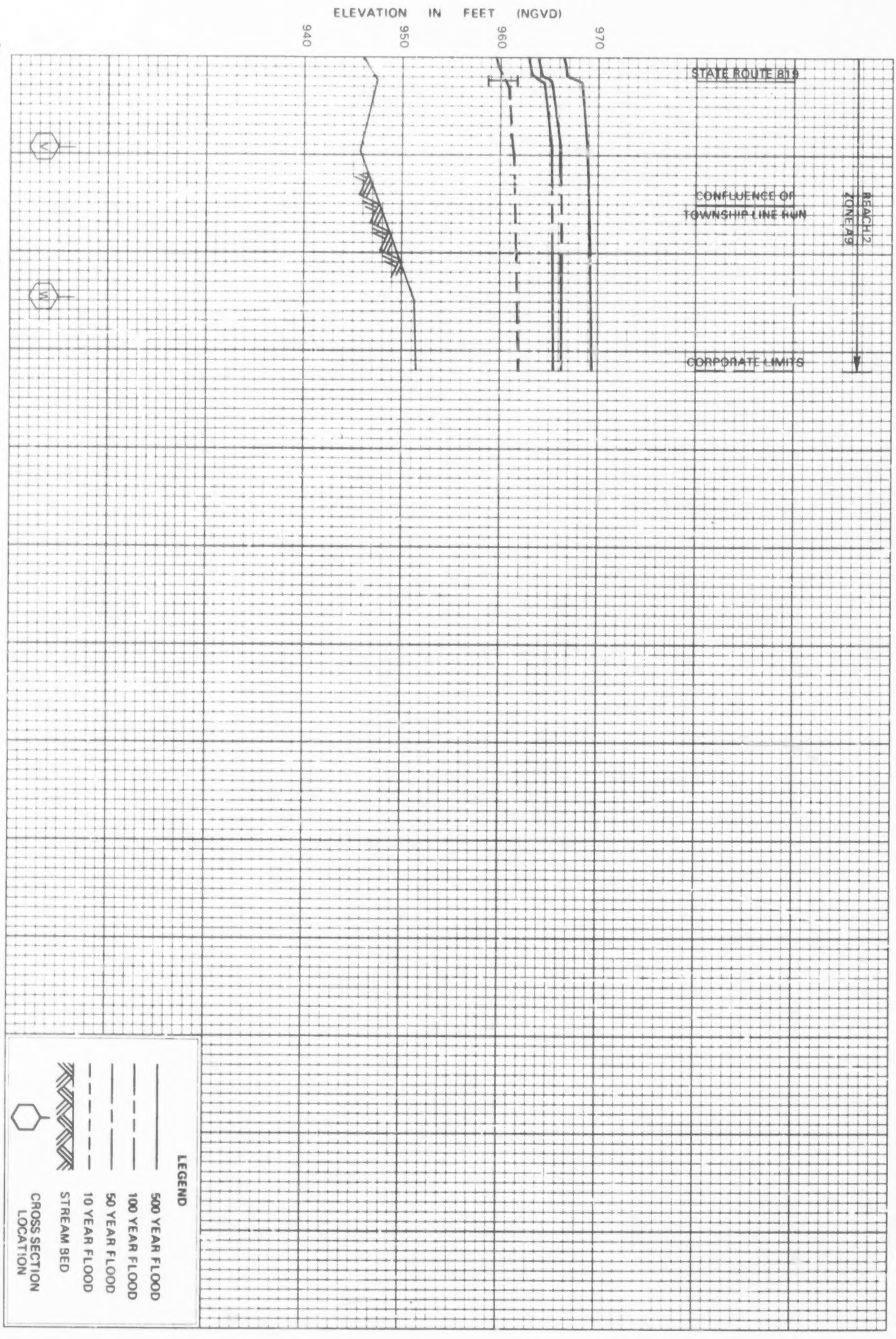
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

(WESTMORELAND CO.)

19P

BEST COPY AVAILABLE



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

(WESTMORELAND CO.)

FLOOD PROFILES

SEWICKLEY CREEK

20P

BEST COPY AVAILABLE

FLOOD PROFILES

JACKS RUN

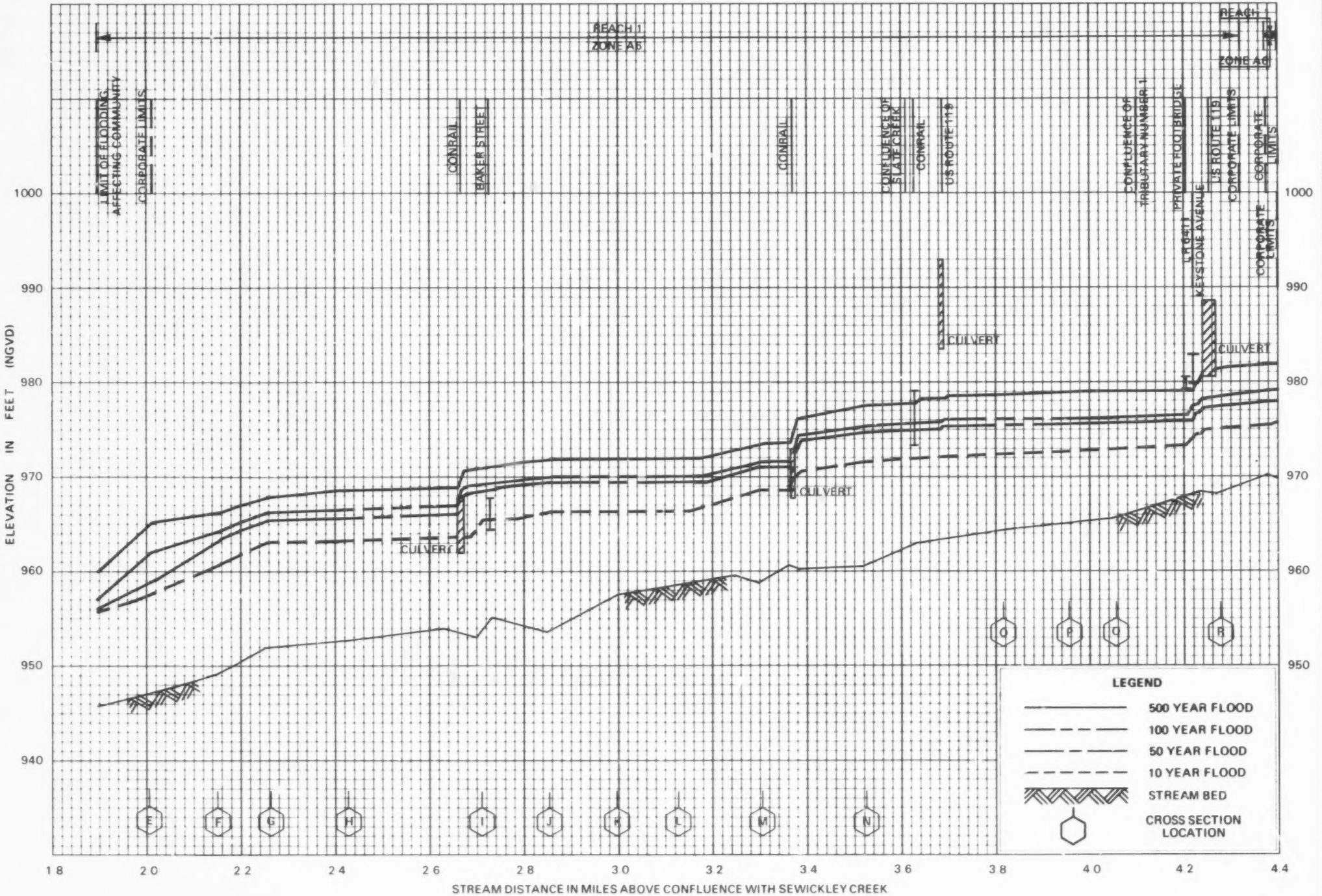
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

(WESTMORELAND CO.)

21P

BEST COPY AVAILABLE



FLOOD PROFILES

JACKS RUN

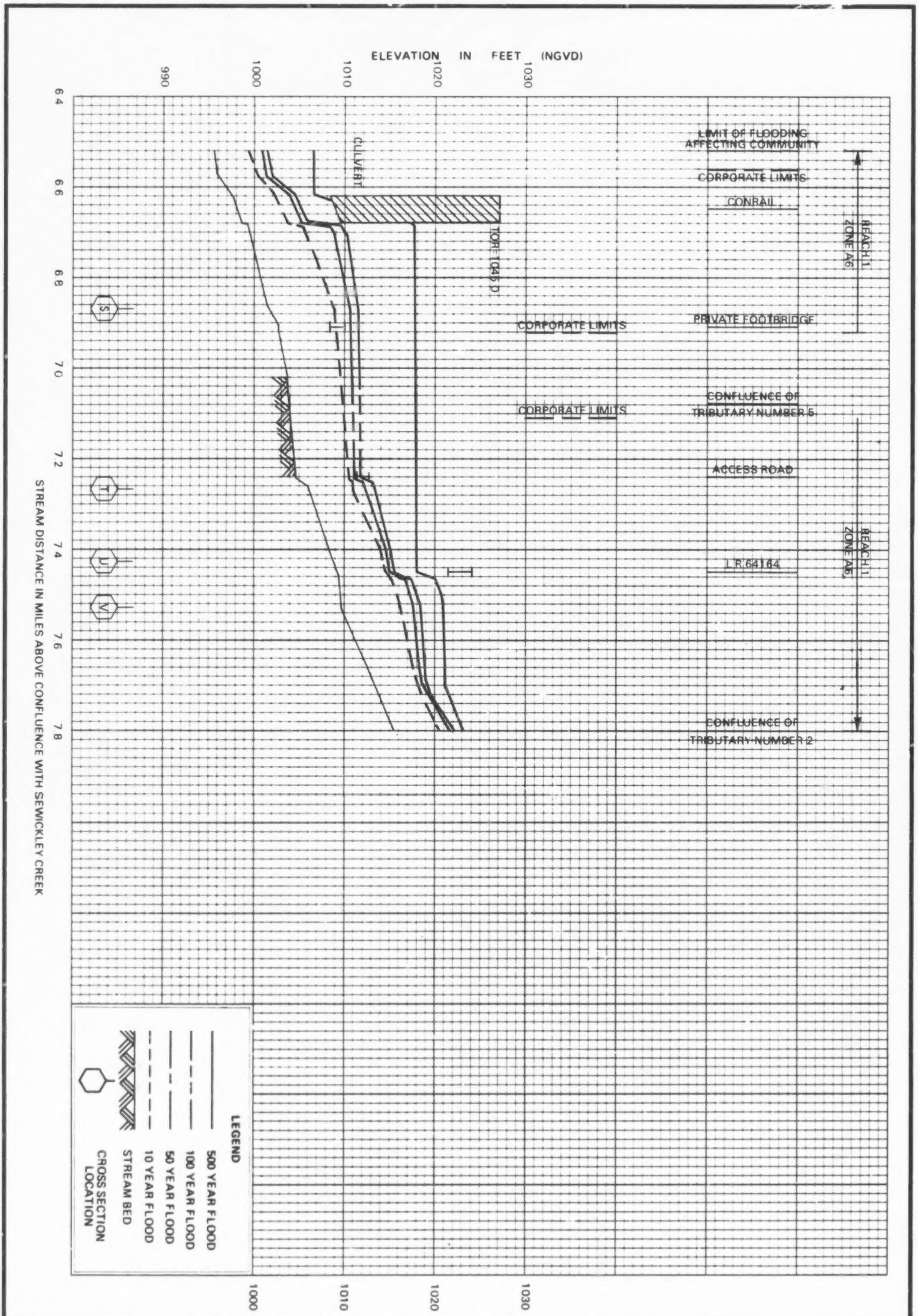
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

(WESTMORELAND CO.)

22P

BEST COPY AVAILABLE



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

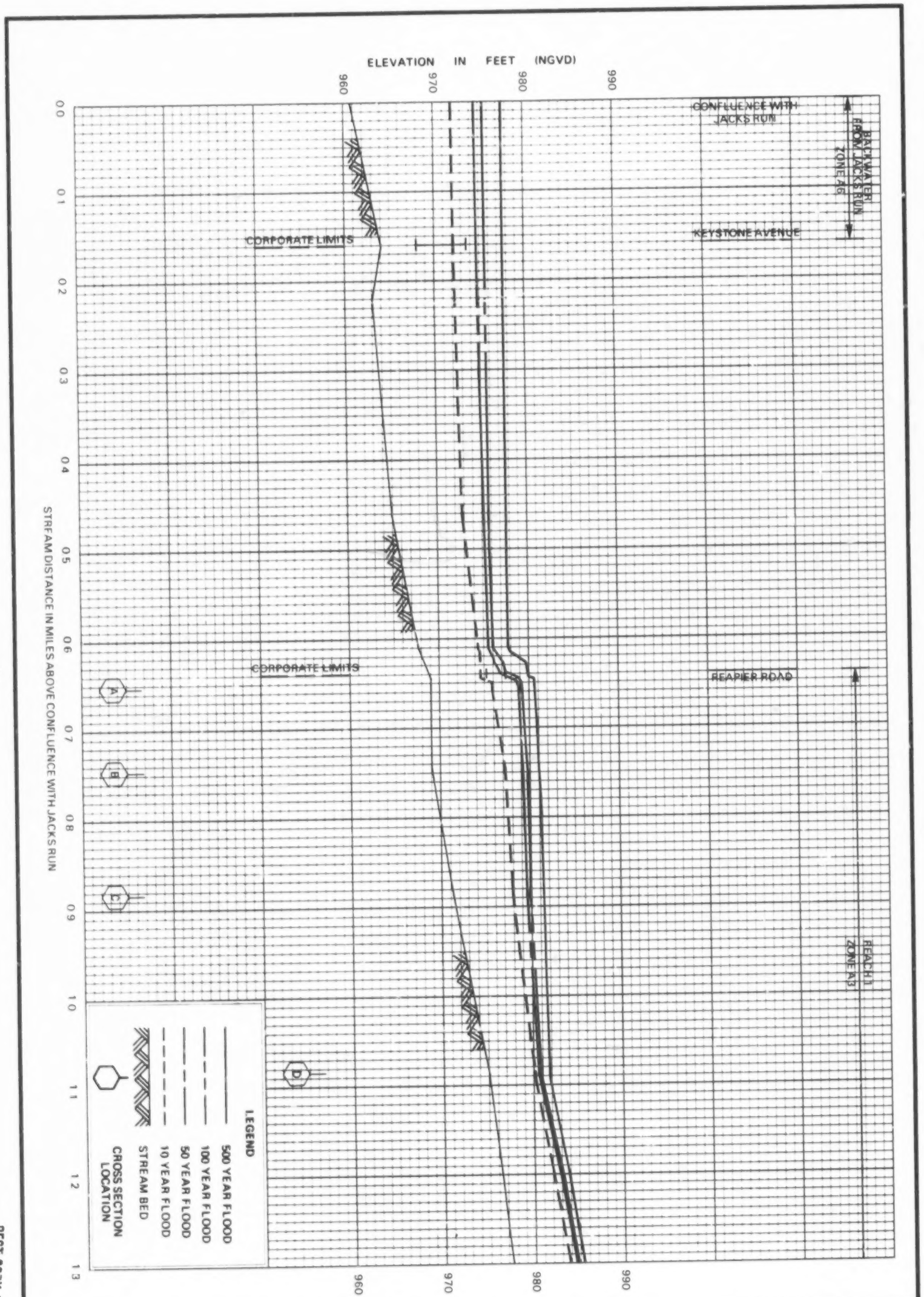
(WESTMORELAND CO.)

FLOOD PROFILES

JACKS RUN

23P

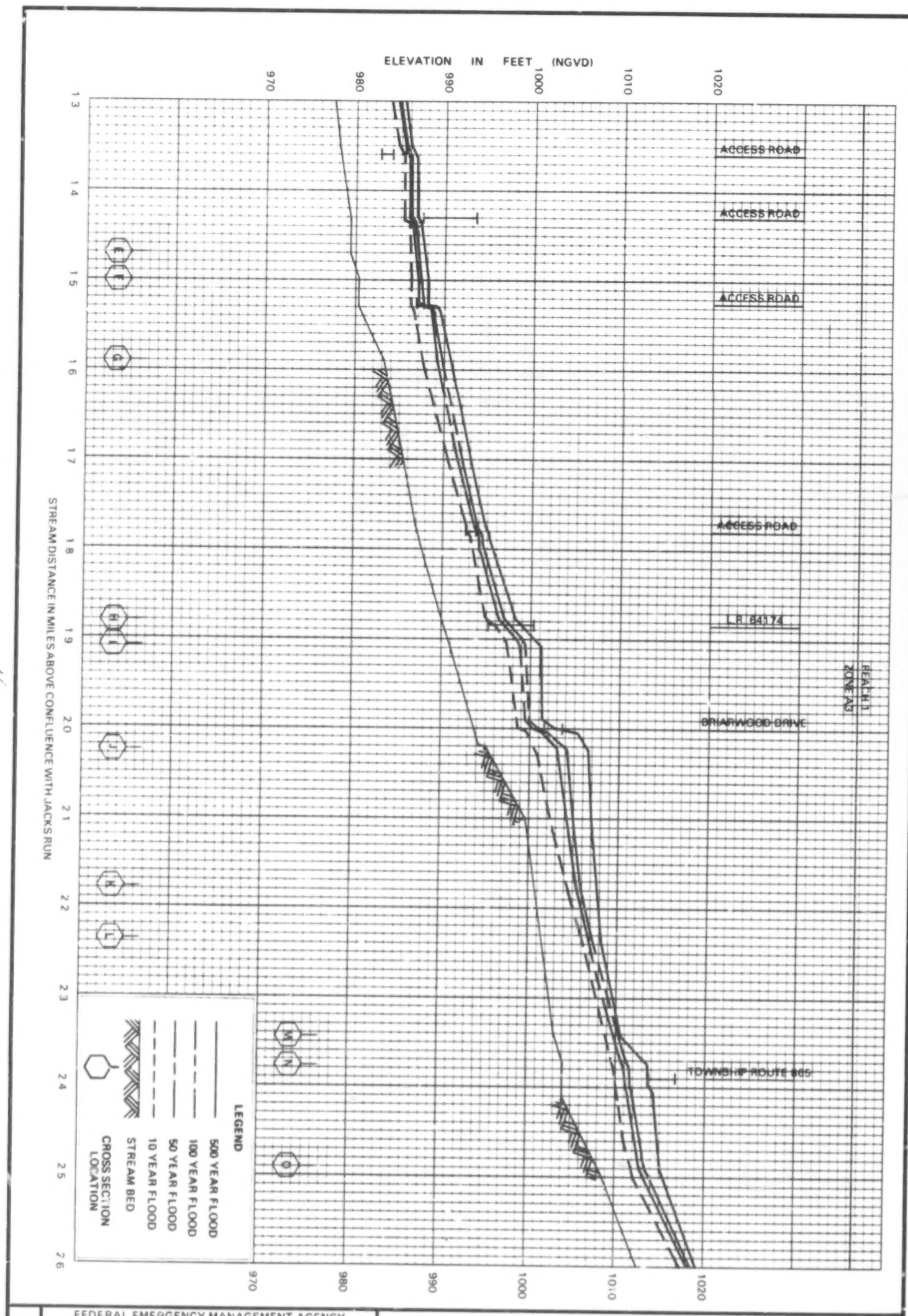
BEST COPY AVAILABLE



24P	FEDERAL EMERGENCY MANAGEMENT AGENCY TOWNSHIP OF HEMPFIELD, PA (WESTMORELAND CO.)	FLOOD PROFILES SLATE CREEK

54

BEST COPY AVAILABLE



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

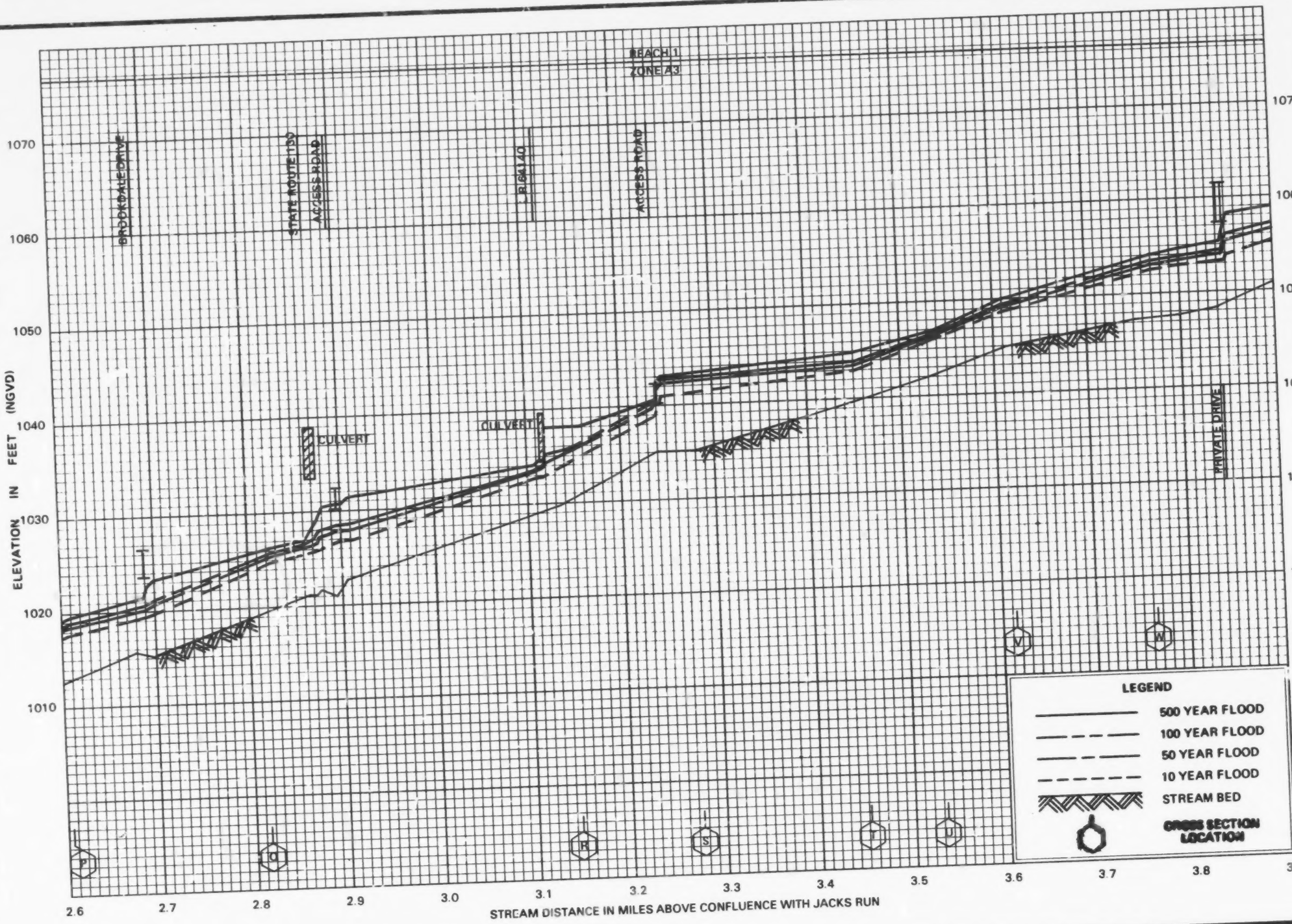
FLOOD PROFILES

SLATE CREEK

25P

55

BEST COPY AVAILABLE



FLOOD PROFILES

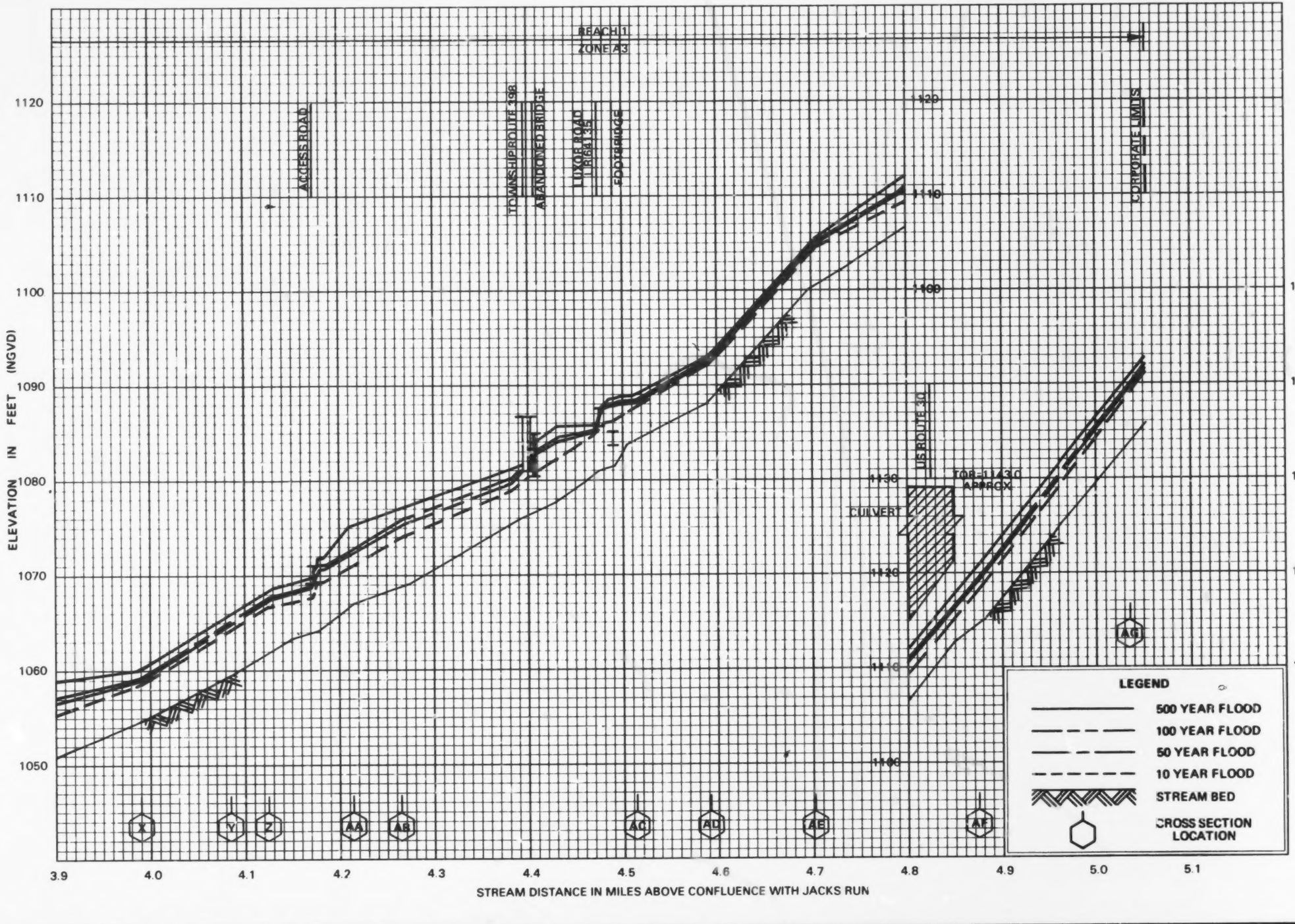
SLATE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

26P

BEST COPY AVAILABLE



FLOOD PROFILES

SLATE CREEK

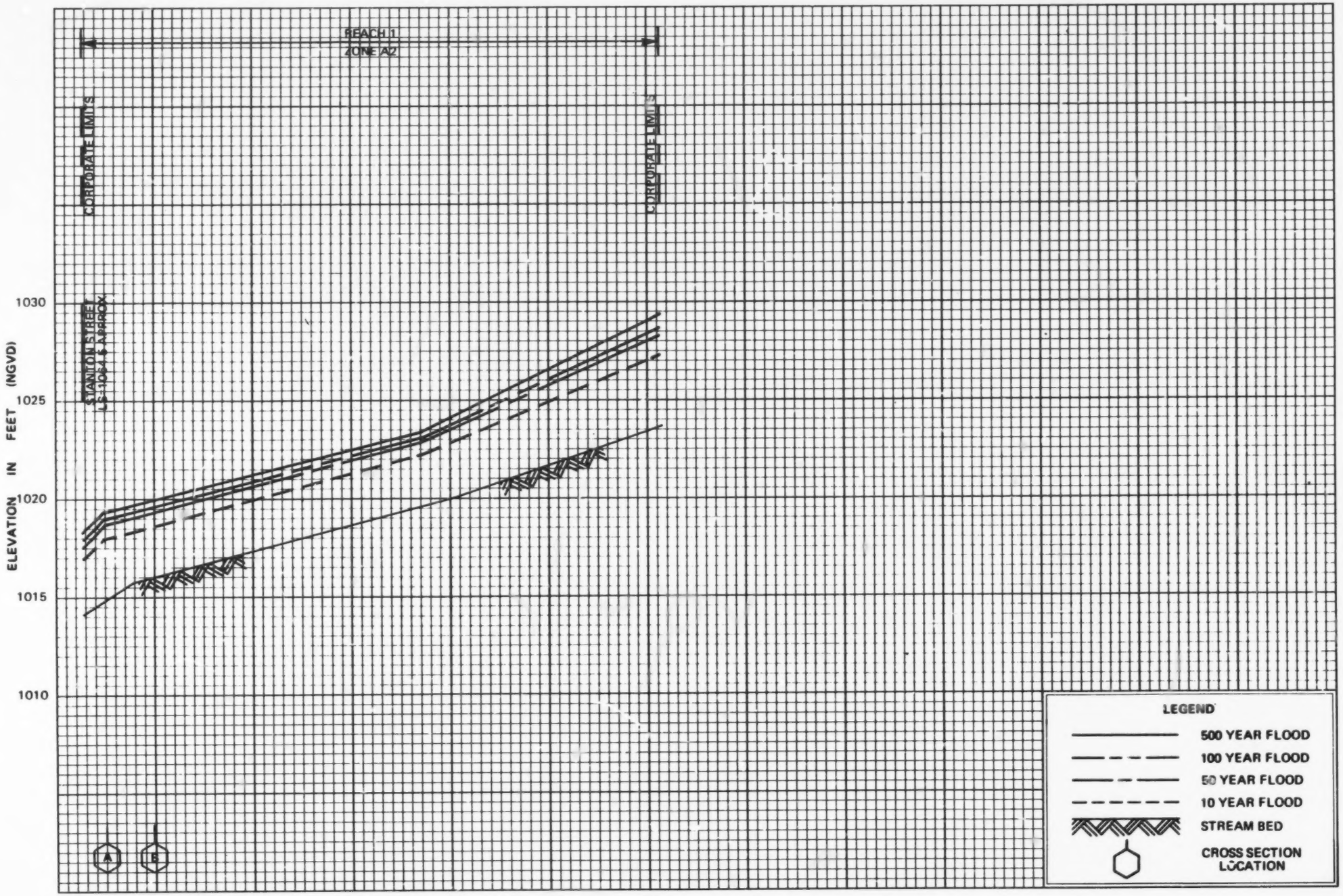
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

(WESTMORELAND CO.)

27P

BEST COPY AVAILABLE



FLOOD PROFILES

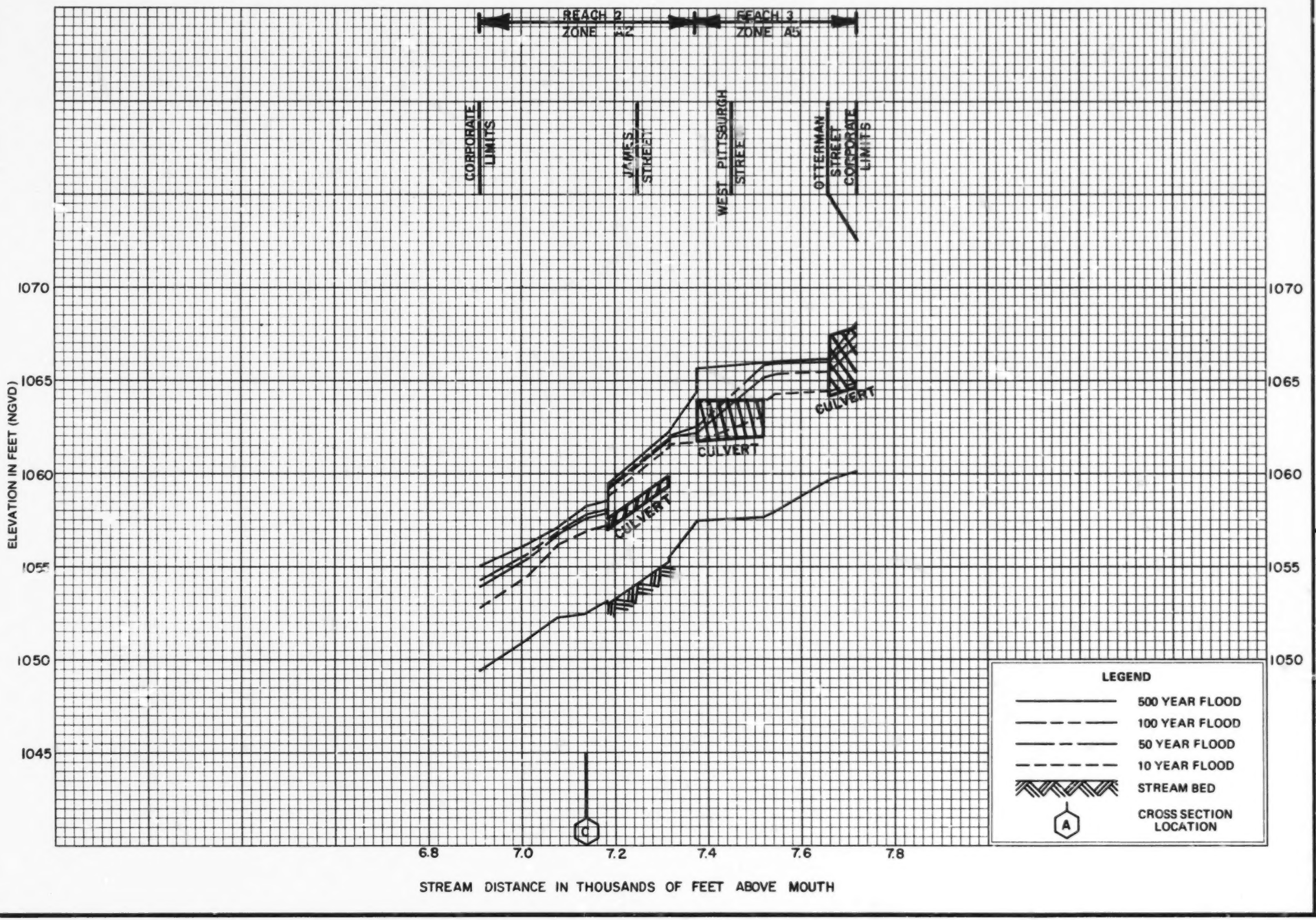
ZELLER'S RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

29P

BEST COPY AVAILABLE



FLOOD PROFILES

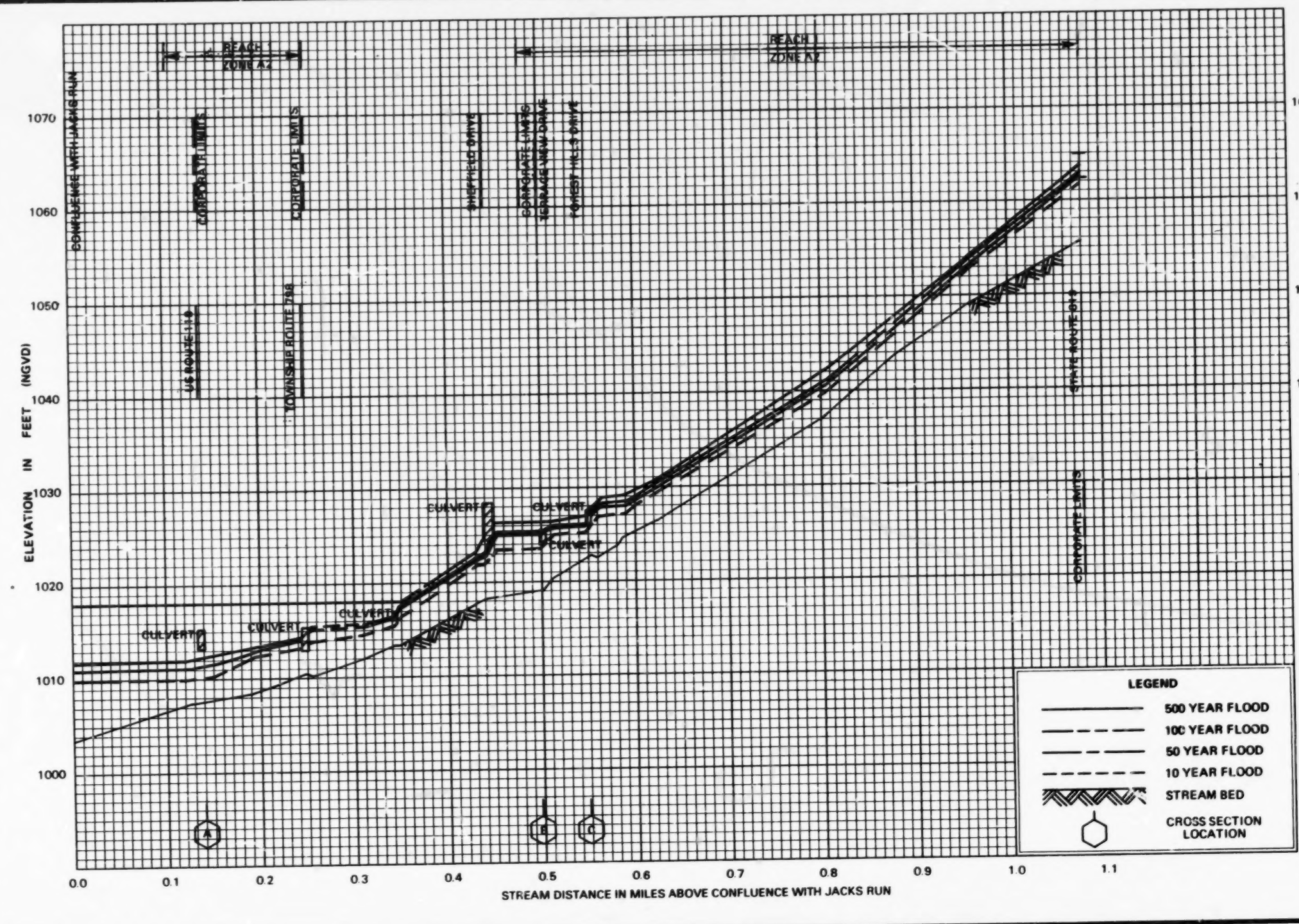
ZELLER'S RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

30P

BEST COPY AVAILABLE



FLOOD PROFILES

TRIBUTARY NO. 5

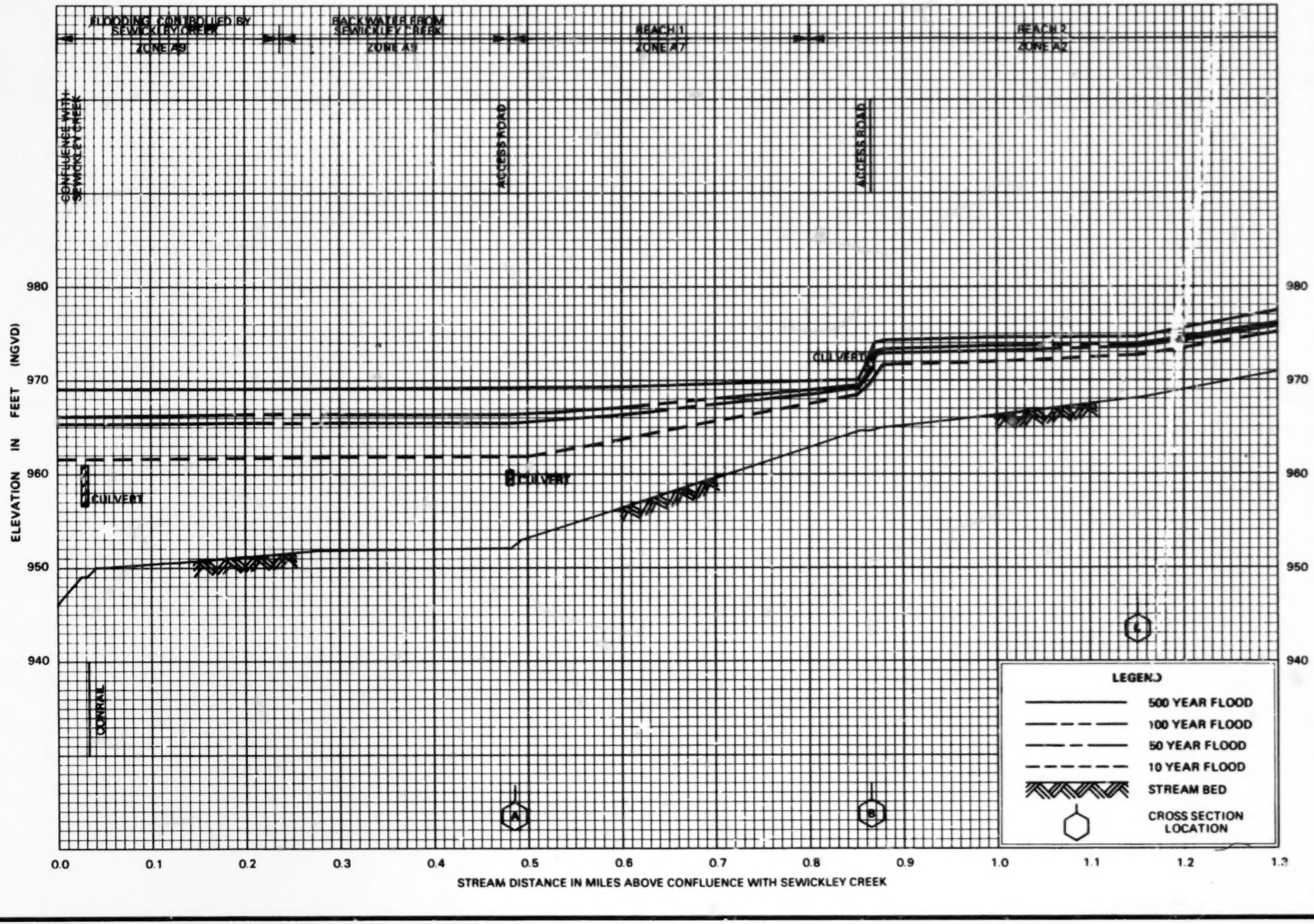
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

(WESTMORELAND CO.)

31P

BEST COPY AVAILABLE



FLOOD PROFILES

TOWNSHIP LINE RUN

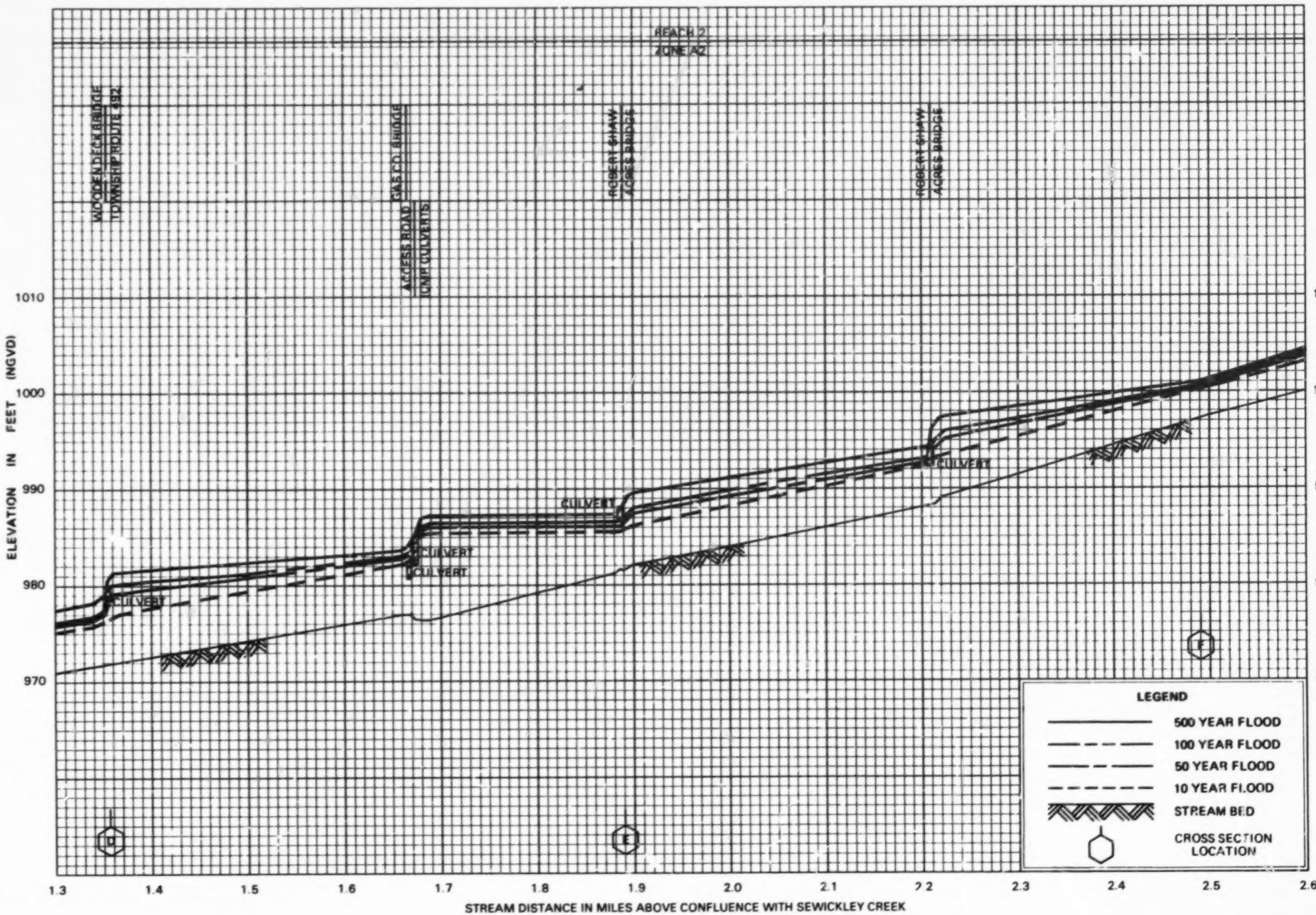
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

(WESTMORELAND CO.)

32P

BEST COPY AVAILABLE



FLOOD PROFILES

TOWNSHIP LINE RUN

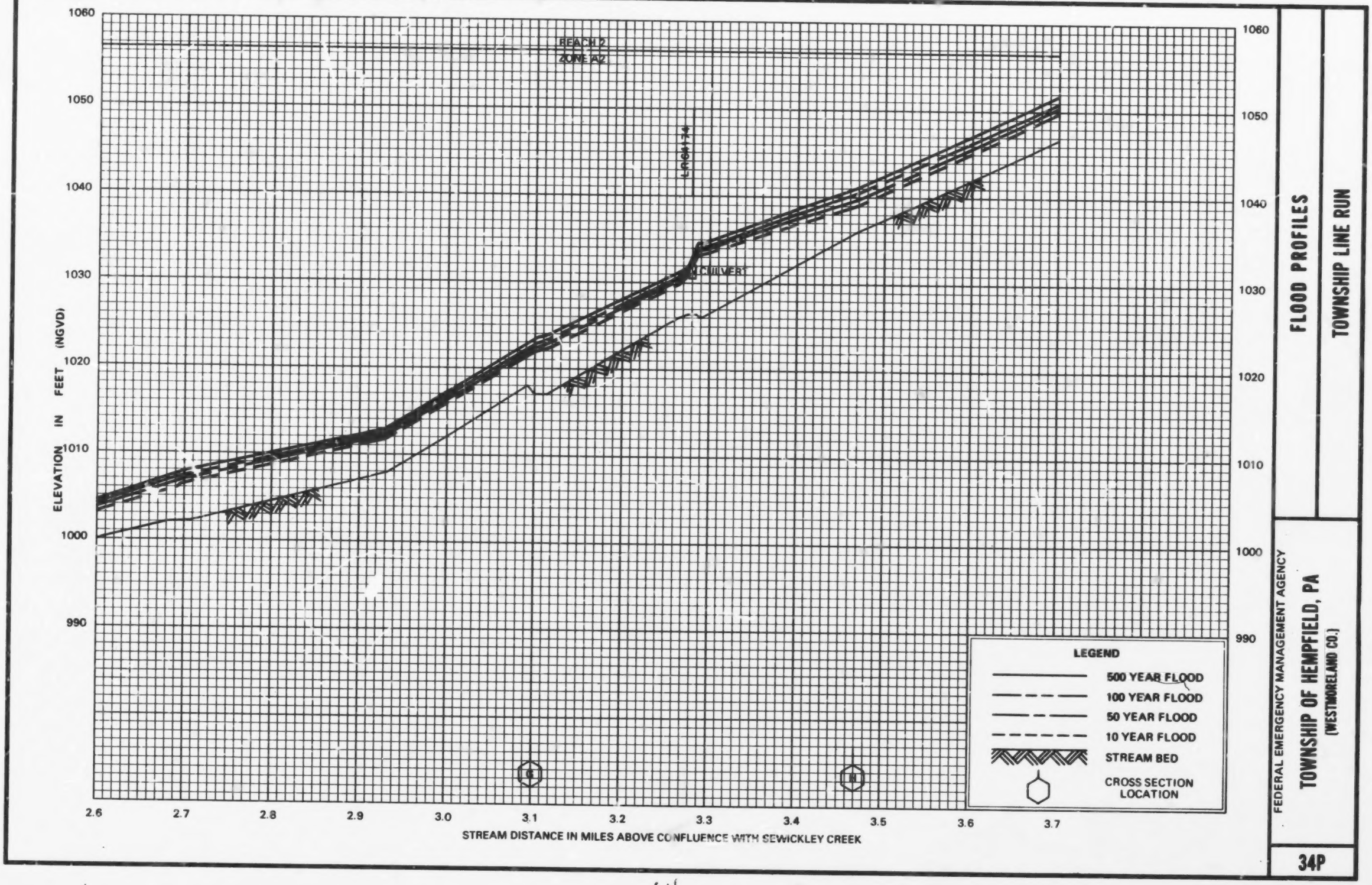
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA

(WESTMORELAND CO.)

33P

BEST COPY AVAILABLE



FLOOD PROFILES

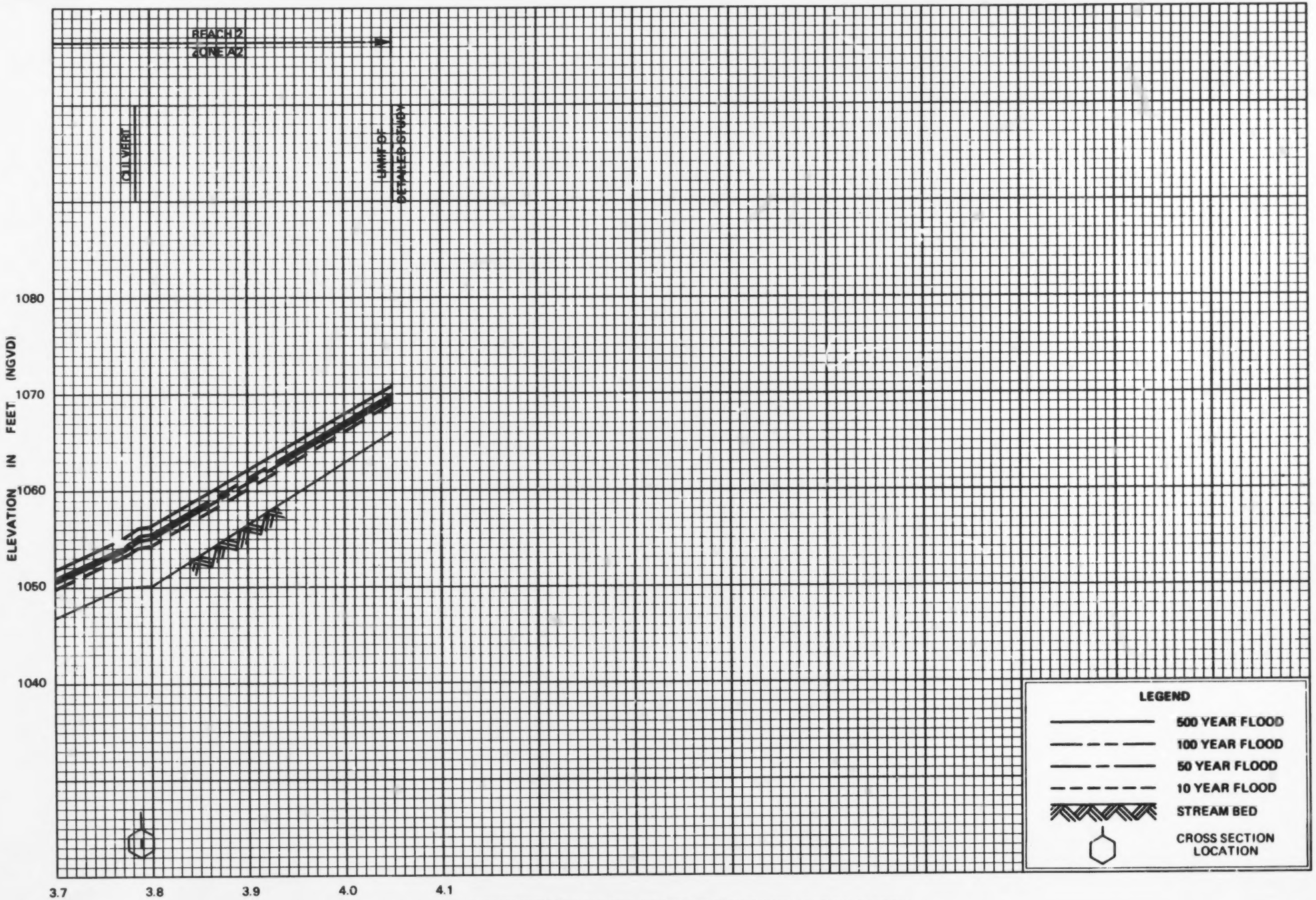
TOWNSHIP LINE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

34P

BEST COPY AVAILABLE



FLOOD PROFILES

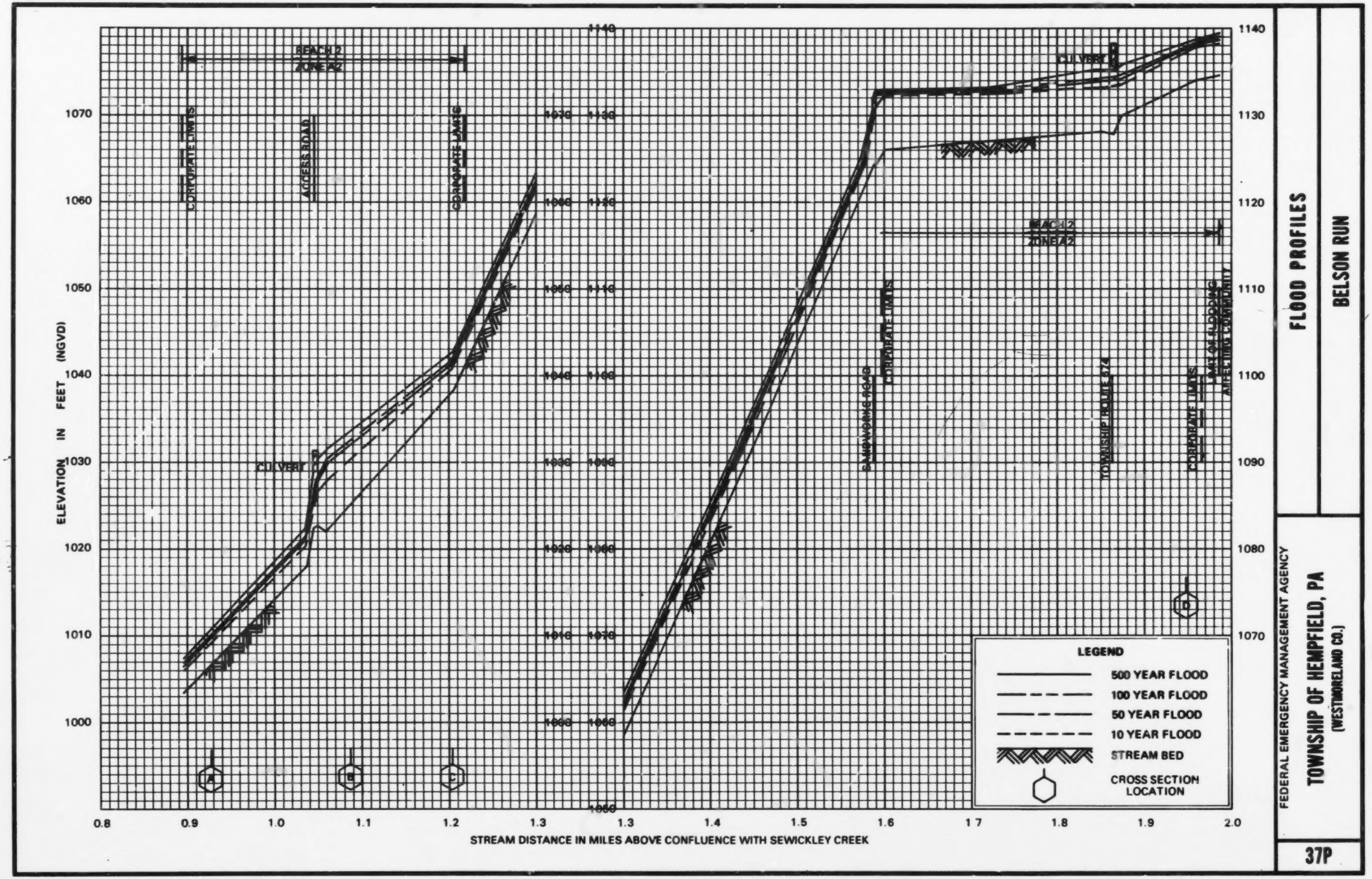
TOWNSHIP LINE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

35P

BEST COPY AVAILABLE



FLOOD PROFILES

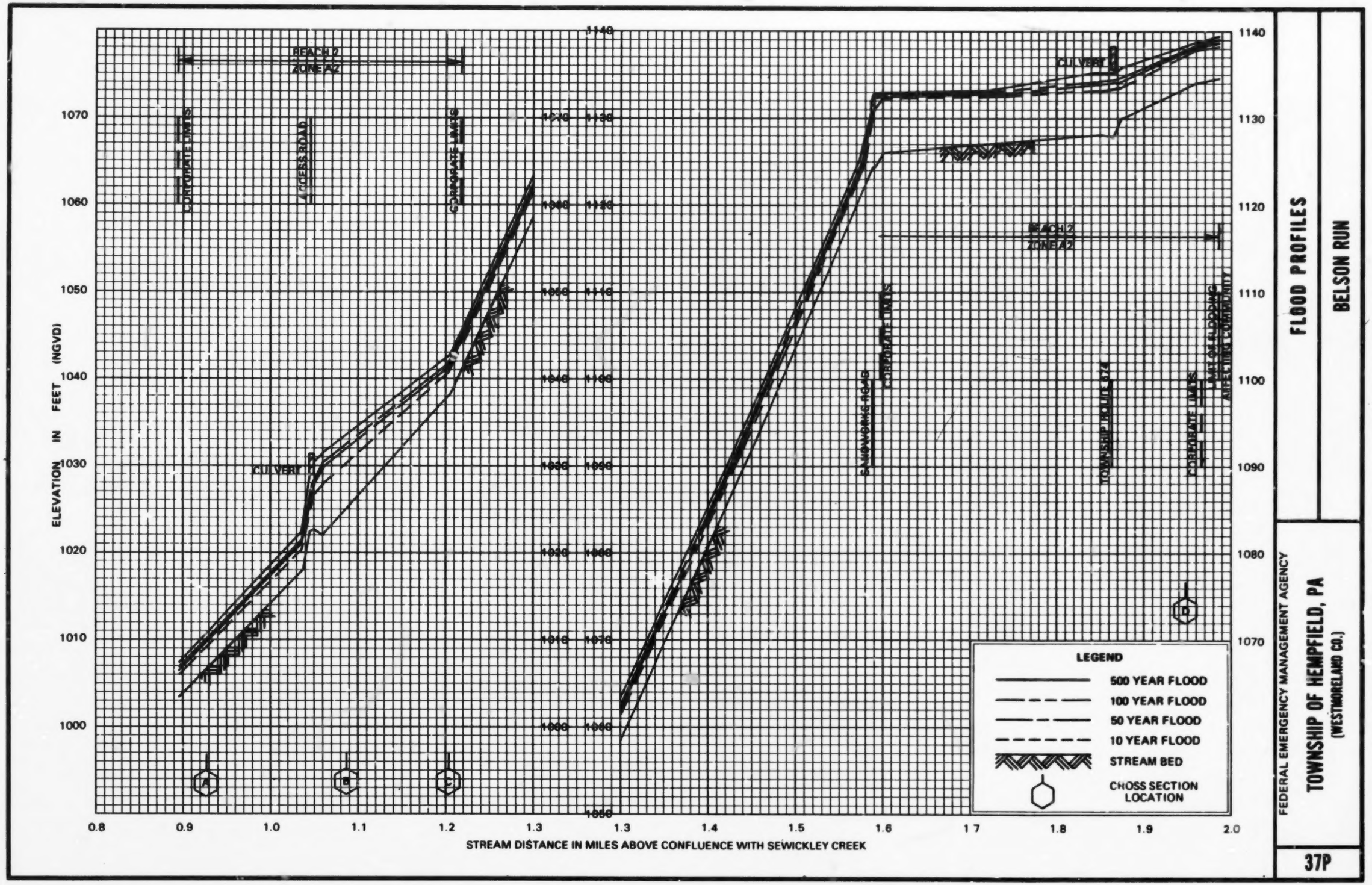
BELSON RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

37P

BEST COPY AVAILABLE



FLOOD PROFILES

BELSON RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HEMPFIELD, PA
(WESTMORELAND CO.)

37P

BEST COPY AVAILABLE